A

NEW and COMPENDIOUS

# SYSTEM

OF

# *Practical Arithmetick.*


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A

NEW and COMPENDIOUS

# SYSTEM

OF

# Practical Arithmetick.

Wherein the DOCTRINE of

Whole NUMBERS and FRACTIONS,

BOTH

VULGAR and DECIMAL,

IS

Fully Explained, and Applied to the ſeveral RULES or METHODS of *Calculation* uſed in TRADE and BUSINESS:

And by ſhewing and comparing

The natural Dependance upon, and Agreement of, one RULE with another, the Whole is render'd more eaſy than heretofore, and the LEARNER is inſtructed in the Vulgar and Decimal Operations together, which at the ſame Time demonſtrates the REASON as well as the PRACTICE of both.

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*By* WILLIAM PARDON, *Gent.*

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# THE PREFACE.

*THE great Number of Books, that are already extant upon this Science, might be a reaſonable Objection againſt this, if the Author could not aſſure the young Student, that the Method this is done in, renders it much eaſier to be underſtood, and conſequently ſooner to be acquir'd, than by any other whatever. The Doctrines of Vulgar and Decimal Arithmetick are here ſo adapted and compared together, as to ſhew the Excellency and Uſefulneſs of both; and to make every Branch the clearer, the ſame Queſtion is often wrought various Ways; by which Means the Learner is let into the Reaſon of the ſeveral Contractions made Uſe of, and ſees the Baſis upon which all ſuch like Operations depend; and by being effectually inſtructed in the Doctrine of Vulgar Fractions, and the Uſes they are or may be apply'd to, is taught from the ſame Principles to make as many more himſelf, as his Occaſions may at any Time require. But above all I would ſeriouſly recommend the Study and Practice of Decimals, whoſe ſuperlative Excellence may be ſeen by the ſeveral Applications exhibited in this Book, and particularly the Contract Method of Multiplication,*

*which for its Eaſe and Expedition deſerves to be univerſally practis'd by all Perſons, where it can be apply'd. Another Reaſon for the Uſe of Decimals, is, that in all fix'd Caſes, you may turn your Diviſor into a Multiplier, which will generally expedite the Work ſo much, and render it ſo eaſy, that every one that tries it will ſoon find its extraordinary Uſefulneſs, eſpecially now the Methods of managing, repeating and circulating Decimals are fully known.*

*It muſt be acknowledged indeed, there are many curious Treatiſes upon particular Branches of this Art, for which the ſeveral Authors deſerve both the Thanks and Encouragement of the Publick; but I think I may, without the leaſt Diminution of another's Glory, ſay, none has handled this whole Subject in ſo natural, full and plain a Manner, ſuited to the Capacities of the Ignorant, as this now preſented to you; from whence I preſume I may promiſe the Learner, that if he will but carefully ſtudy the Rules, and mind the various Methods of doing the ſame Thing here exhibited, he muſt, in a little Time, be a much greater Proficient in this Art, than he can be by uſing any other Book whatever.*

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OF

OF

# ARITHMETICK.

## CHAP. I.

*Containing the Definition of* ARITHMETICK, *and the* NOTATION *or Manner of expreſſing Numbers, both in Words and Figures.*

ARITHMETICK *is the Science, Art or Knowledge of Numbers, with their various Applications in Numbering.*

*Number* is that by which we find out, know, or expreſs how many equal Parts any whole Thing or Quantity is made up of: And here the great Queſtion ſo long agitated among the Learned, will properly be decided, *viz.*

Whether *Unity* or *One* be a Number?

*Euclid* is frequently brought in as a Party favouring both Sides; but that in the Nature of the Thing is impoſſible: For nothing is clearer than the Affirmative, or that *Unity* is abſolutely a Number, and not, as ſome imagine, the Beginning of Number. For,

*Firſt*, Whenever we expreſs the Quantity or Aggregate of any whole Thing, we call it *Unity* or *One*, let it conſiſt of ever ſo many Parts; as one Shilling, tho' it contains Twelve-

 pence;

pence; or one Penny, tho' it is made up of four Farthings; or one Pound *Sterling*, or *Engliſh* Money, which is made up of twenty Shillings, or two hundred and forty Pence, or nine hundred and ſixty Farthings, *&c.* Under theſe Circumſtances no Body will ſay that *Unity* or *One* is not a Number; for ſurely, if the Parts 12, 4, 20, 240 or 960 are Numbers, the Total compounded or made up of thoſe Parts, muſt be a Number, as well as the Parts compounding: For, according to the ſyllogiſtick Method of Reaſoning:

The Whole is of the ſame Nature, Matter, Quality or Subſtance with the Parts 'tis compounded of.

But Unity may be conſidered both as a Part of a Multitude of Unities, and alſo as an Aggregate or Total.

Therefore Unity is of the ſame Nature or Quality with a Multitude, Total or Aggregate of Unities.

But the Matter or Subſtance of a Multitude of Unities, is Number.

Therefore Unity is Number.

Now if any one denies this, let any Number be given, as ſuppoſe 3. From this let Unity or 1 be ſuſtracted or taken away, three diſtinct Times. And if Unity be nothing, or no Number, then 3, or the given Number, will ſtill remain; but, this is ſo evidently falſe and abſurd, that 'twould be idle to ſay any more about it. Therefore we conclude that Unity or 1 is a true, real and abſolute Number.

And indeed, let any Number given be ever ſo great, it, properly ſpeaking, is but *Unity* or one Total, Aggregate, Sum, or whole Thing, made up of a certain Quantity of leſſer Unities or Parts; as a Thouſand, a Million, *&c.* And for the eaſy Expreſſion of the Quantity of Parts, any Whole is made up of, both in Words and Symbols, many different Methods have been invented; ſome by Letters of the Alphabet, and others by Characters appropriated to Numbers only; which latter, as they are both more commodious, and alſo univerſally received, ſhall be here explained, *viz.* 1, 2, 3, 4, 5, 6, 7, 8, 9, 0. which virtually contain all that is capable of being performed in or by Numbers, according to the common, and indeed beſt and moſt univerſal Scale now in practice: For as all Operations in Numbers are only the adding or ſubſtracting one or more of theſe Quantities or Numbers, to or from one another, ſo you are to take Notice that the ſaid nine Figures expreſs ſo many different whole Things, conſiſting of ſo many Parts as are repreſented by the Character made uſe of, *viz.* 1 ſignifies ſome one whole Thing or Part,

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Part, abſolutely, without any Subdiviſion or Parts of which it is made up; as one Shilling, one Pound, one Yard, *&c.* 2 ſignifies ſome Thing or Number made up of two equal Parts, as two Sixpences make one Shilling, *&c.* 3 repreſents a whole Thing of three equal Parts, 4 ſomething of four equal Parts, 5 of five equal Parts, 6 of ſix equal Parts, 7 of ſeven equal Parts, 8 a Thing or Number made up of eight equal Parts, and 9 ſomething of nine equal Parts. The other Mark or Character, 0, ſimply of itſelf ſignifies nothing, but in plain or poſitive Arithmetick is uſed to increaſe or repeat the Value of the ſignificant Figure, Ten, a Hundred, a Thouſand, *&c.* Times, according to the reſpective Place or Places it occupies; and in artificial or negative Arithmetick, commonly called Decimals, it decreaſes the Value of the ſignificant Figures in a decuple or tenfold Proportion.

In the Practice of *Arithmetick* there are two principal Parts, the firſt called *Notation*, the ſecond *Numeration*. Now the common Method in Schools is (tho' falſly) to call *Notation* by the Name of *Numeration*, which you will preſently be taught, is quite another Thing.

NOTATION *is that Part of Arithmetick that teaches you to note or write down in Characters, or expreſs in Words, how many equal Parts, or Unities, are contained in any whole Number or Thing whatever.*

You are to obſerve, that the commonly receiv'd Method of operating Numbers, is by the decuple Scale, or that wherein the ſame Figure is increaſed ten Times, by being placed or ſet one Stage or Place more backward, toward the Left-hand, than it or another of the ſame Value ſtood in before; but for the eaſy Expreſſion of Numbers in their ſeveral Places or Stages of Value, there are appropriated particular Words or Names, *viz. Units, Tens, Hundreds*; that is, all the Figures that ſtand ſingly or alone, are called *Units*; when uſed, applied, or conſidered either abſtractedly, as Numbers only, or apply'd to Buſineſs, when ſome Adjunct is joined to the Number to ſpecify the particular Species or Goods intended: Thus, 1, 2, 3, 4, 5, 6, 7, 8, 9, are ſimply Numbers, or they may be ſo many *Crowns, Kingdoms, Men, Sheep, Plumbs, Apples*, &c. Some call theſe ſingle ſignificant Figures *Digits*; but when they are compounded, either by repeating the ſame Figure, prefixing one or more Noughts or Cyphers before them, or mixing them indifferently together; the firſt Place towards the Right-hand, is called the Units Place, or the Figure

ſimply; the ſecond towards the Left-hand, is ſo many Tens as the Figure expreſſes ſimply Units; and the third Place towards the Left-hand, is ſo many Hundreds. The *fourth*, *fifth*, and *ſixth* Places, are a Repetition of *Units*, *Tens*, *Hundreds* again; only there is added the Word or Term *Thouſands*. So the *ſeventh*, *eighth* and *ninth* Places, are again a Repetition of *Units*, *Tens* and *Hundreds*, with the Word or Term *Millions* added to them. Now this Variety of Terms or Names, is a modern Invention, and is not abſolutely neceſſary, but is now generally us'd, becauſe in Practice 'tis found more commodious than the Repetition of the former Terms or Expreſſions many Times over, as was the Cuſtom of the Antients in large Numbers; who us'd to ſay a *Thouſand Thouſand* for a *Million*, or *ten Thouſand* times *ten Thouſand* for a *hundred Millions*: For 'tis the ſame Thing if you ſay *Tens* of *Tens*, inſtead of *Hundreds*, and *Tens* of *Tens* of *Tens* inſtead of *Thouſands*. Or you may ſay *Tens* of *Hundreds* inſtead of *Thouſands*, and *Hundreds* of *Hundreds* inſtead of *Tens* of *Thouſands*; but the commonly receiv'd Method is both ſhorter and clearer, and therefore you ſhall ſee it fully explain'd by what follows.

But, firſt, I muſt inform you, that all Numbers are made by a continual Addition of *Unity* to itſelf; and the Numbers ſo ariſing are called as follows.

1 one, 2 two, 3 three, 4 four, 5 five, 6 ſix, 7 ſeven, 8 eight, 9 nine, 10 ten, 11 eleven, 12 twelve, 13 thirteen, 14 fourteen, 15 fifteen, 16 ſixteen, 17 ſeventeen, 18 eighteen, 19 nineteen, 20 twenty, 21 twenty one, 22 twenty two, *&c.* till you come to 29 twenty nine; then you ſay 30 thirty, 31 thirty one, *&c.* till you have gone thro' all the ſignificant Figures; and then you ſay 40 forty, 41 forty one, *&c.* and then 50 fifty, 51 fifty one, *&c.* 60 ſixty, 61 ſixty one, *&c.* 70 ſeventy, 71 ſeventy one, *&c.* 80 eighty, 81 eighty one, *&c.* 90 ninety, 91 ninety one, *&c.* then 100 one hundred, 200 two hundreds, *&c.*

| *Hundreds* | *Tens* | *Units* | *Hundreds* | *Tens* | *Units* | *Hundreds* | *Tens* | *Units* | *Hundreds* | *Tens* | *Units* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 1 | 2 | 2 | 2 | 3 | 4 | 5 | 7 | 0 | 0 |
| | | | 5 | 0 | 7 | 9 | 8 | 0 | | | |

Here the firſt *Ternary* or Article conſiſting of three Figures are all *Ones* or *Units*, and as they ſtand compounded, and each

each of them repreſents one Sum, they are to be read thus; beginning at the laſt or third Figure towards the Left-hand, I find it to be an *Unit* or *One*, and over it is wrote the Term, Name, or Word *Hundreds*; therefore I call it *one Hundred*. The ſecond Figure is alſo an *Unit*, and the Name *Ten* being over it, I call it *one Ten*; which compounded with, or added to the *Hundred* makes *one Hundred* and *one Ten*, or an *Hundred* and *Ten*. The next Figure towards the Right-hand, ſtanding in the Units Place, and being alſo *One* is ſo called; and being compounded with or added to the other two towards the Left-hand, and ſo conſidered as one whole *Number* or *Sum*, it makes *one Hundred*, *one Ten* and *One*; which in common Language would be called *one Hundred* and *Eleven*. And this Number expreſſes any whole Thing or Quantity divided into ſo many equal Parts: As, ſuppoſe a *Purſe* or *Sum* of Money of an *Hundred* and *Eleven Guineas*; a *Ship* whoſe Complement of Men was an *Hundred* and *Eleven*; or the *great Guns* in a firſt Rate Man of War may be *one Hundred* and *Eleven:* And ſo of any thing elſe.

The ſecond *Ternary* or Article of three Figures are all *Two*'s, and in like manner are to be read, *two Hundreds*, *two Tens*, or *twenty*, and *two*; which is read thus, *two Hundred twenty two*; and this repreſents any whole Thing, compounded or made up of ſo many equal Parts.

The third *Ternary* is made up of all different Figures, which are to be read or valued thus; the firſt Figure towards the Right-hand ſtands for its own ſimple Value, *viz. five*, becauſe it ſtands in the *Units* place; the ſecond towards the Left-hand is *four Tens*, or *Forty*, becauſe it ſtands in the Place of *Tens*; and the third is *three Hundreds*, becauſe it ſtands in the Place of *Hundreds*; and the whole taken together, as one *Number* or *Sum*, muſt be called *three Hundred forty five*.

The fourth and laſt *Ternary* towards the Right-hand has but one ſignificant Figure, which is that which ſtands in Place of *Hundreds*; and therefore that *Number* or *Sum* muſt be called *ſeven Hundreds* only.

There are two other *Ternaries* put underneath the ſecond and third *Ternaries* already explained, *viz.* 507 and 980; the firſt of which muſt be read *five Hundred and ſeven*, becauſe 0 ſupplies the Place of *Tens* in that *Ternary*; and the other muſt be read *nine Hundred and Eighty*, becauſe 0 ſupplies the Place of *Unity*, and therefore there are only *Hundreds* and *Tens*, and no *Units*. --- If you would number more Figures than three, do as follows; firſt, part them into *Ternaries*,

*Ternaries*, and obſerve what additional Name or Term is put to it, beſides the *Units*, *Tens* and *Hundreds*; as here:

| Of Thouſands of Millions. | | | Of Millions. | | | Of Thouſands. | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Hundreds* | *Tens* | *Units* | *Hundreds* | *Tens* | *Units* | *Hundreds* | *Tens* | *Units* | *Hundreds* | *Tens* | *Units* |
| 7 | 9 | 5 | 8 | 6 | 6 | 3 | 2 | 4 | 6 | 9 | 8 |

The *fourth*, *fifth* and *ſixth* Places, which is the ſecond *Ternary* towards the Left-hand, are ſo many *Units*, *Tens* and *Hundreds* of *Thouſands*. The *ſeventh*, *eighth* and *ninth* Places, which is the third *Ternary* towards the Left-hand, are ſo many *Units*, *Tens* and *Hundreds* of *Millions*. The fourth *Ternary* is ſo many *Units*, *Tens* and *Hundreds* of *Thouſands* of *Millions*: And ſo you may go on to as many Figures as you pleaſe; but theſe twelve Places or Figures are more than ſufficient for any Thing that can poſſibly happen in Trade or Buſineſs; and therefore I ſhall forbear going further, and only ſet down in Words the twelve Figures above, *viz. Seven Hundred and ninety five Thouſand eight Hundred and ſixty ſix Millions, three Hundred and twenty four Thouſand ſix Hundred and ninety eight.* --- So 60,000,000,700 ſtands for *ſixty thouſand Millions and ſeven Hundred*; and 9,210,000,000 ſtands for *nine Thouſand two Hundred and ten Millions*; 815,900,035 ſtands for *eight Hundred and fifteen Millions, nine hundred Thouſand and thirty five.* Thus by obſerving the Place of any Figure you will preſently know its Name, and *Vice Verſa*, by the Name its Place: As ſuppoſe 'twas demanded what Figures would expreſs the Number *forty Millions forty Thouſand four Hundred and forty*; by comparing the Names and Places in the above 12 Figures, I find that 40,040,440 will do what was required. So if *fifty ſeven thouſand Millions* were wanted, I muſt write down 57,000,000,000. Thus may you with Eaſe and Certainty expreſs both in Words and Figures any Number you can poſſibly want.

Now follows *Numeration*, which comprehends all the Practice of *Arithmetick*, beſides that of *Notation*; but more particularly what is called the four principal Rules, *viz. Addition*, *Subſtraction*, *Multiplication*, and *Diviſion*; all others being

being but a particular Application or Compoſition of theſe. And as Trade or mercantile Buſineſs has a more immediate Demand for the Aſſiſtance of this Art, therefore I ſhall particularly have regard ſo to accommodate every Branch, that they, whoſe former Education has not enabled them, or whoſe preſent Leiſure will not permit them to make deep Searches into the hidden Myſteries of this excellent Science, may be profitably improv'd in the eaſier and more common Parts thereof.

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## CHAP. II.

### *Of the* Addition *of whole or abſtract Numbers; alſo the Method of finding the Total or Amount of ſeveral Sums or Numbers of diverſe Denominations.*

ADDITION *is that Rule or Method of handling Numbers, by which the Amount, Total or Aggregate of any two or more Sums or Numbers, either of the ſame or of a different Value, may be found:* And this may be conſidered under two Names, *viz. Addition* and *Multiplication*, the latter being only a particular Mode or Manner of performing the former, as ſhall be ſhewn by and by, and therefore ought to ſtand in the ſecond Place, or next to *Addition*, having no Dependence upon that commonly taught in the ſecond Place, *viz. Subſtraction*. And as my Buſineſs ſhall be to ſhew you how you may work, prove, and know the Truth of every Rule independently, ſo I ſhall not ſcruple to go out of the common Road both of *Schools* and *Authors*, when 'tis for the Advantage of communicating Knowledge to the Learner more eaſily and convincingly. This Rule depends upon, and is an Illuſtration of the following Axiom, *viz.*

*The* Whole, Total, Sum *or* Aggregate, *of any Number or Thing, is equal to all the Parts whereof 'tis made up, or compounded.*

But every Number conſiſts either of one *Unit* or a Multitude of *Units*; therefore the Adding or Collecting of *Units* into one *Total* or *Sum*, muſt neceſſarily produce all other Numbers above *Unity*; as 1 and 1 make 2; 1, 1 and 1, or 2 and 1, make 3; ſo 1, 1, 1 and 1, or 3 and 1, make 4; and 1, 1, 1, 1 and 1, or 4 and 1, make 5; ſo 1, 1, 1, 1, 1, and 1, or 5 and 1, make 6; and 1, 1, 1, 1, 1, 1 and 1, or 6 and 1, make 7; and 1, 1, 1, 1, 1, 1, 1 and 1, or 7 and 1,

make

make 8; ſo 1, 1, 1, 1, 1, 1, 1, 1 and 1, or 8 and 1, make 9, *&c.* For let the Number be ever ſo large, 'tis only the *Sum*, *Total*, or *Amount* of ſo many *Units* added together; as 75 is the Sum of *ſeventy five* Units, 659 is the Sum of ſo many *Units*. The like 'tis of all other whole Numbers whatever; but as 'twould be too tedious to work large Sums in this Manner, tho' 'tis ſtrictly true, I will ſhew you another Method which is more expeditious. And as the Knowledge and ready Uſe of Numbers, like all other Arts, comes by repeated Acts; ſo the firſt Thing to be learnt will be to know the Amount of two ſingle Numbers; as of 7 and 5, 6 and 9, *&c.* And here the eaſieſt Method will be to write down progreſſively all the ariſing Numbers from Unity to Fifty, thus: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, *&c.* for you may go on to 100, or more, if you pleaſe. Begin at 7, and count five *Places* or *Numbers* from *ſeven* towards the Right-hand, and you will come to 12; and that is the *Sum* or *Total* of 7 and 5. Again, What's the Sum of 6 and 9? Here I begin and count nine Places forward from 6, and then I come to 15, which is the Anſwer, or Sum of 6 and 9. In the ſame Manner you may find the *Sum* of 3 and 8 to be 11; for counting 8 *Places* from 3, you will come to 11. And here you may obſerve, that you may begin from either of the two Figures; as in the laſt *Example*: Suppoſe I count *three* from the *eighth Place*, I ſhall find 8 and 3 to be 11, as well as 3 and 8. So in 6 and 9, if I count *ſix Places* from *Nine*, I ſhall come to 15, the ſame as when I counted *nine Places* from *Six*. Again, *What is the Amount of* 5, 6, 8, 9, 6? Here I begin to count *ſix Places* from *five*, and find the Amount to be 11; then I count 8 *Places* from 11, and find that *Sum* to be 19; then I count 9 *Places* ſtill forwards towards the Right-hand, from 19, and find that *Amount* to be 28; from that *Place* I count *ſix Places* more towards the Right-hand, and find that *Amount* to be 34; and that is the *Sum*, *Total*, or *Amount* of all the *five Figures*, when collected into *one Aggregate*: For the Proof whereof you may begin and go backwards with the *Figures*, thus: Begin at the Right-hand fix, and find what 6 and 9 is, and the *Table* tells you 'tis 15; then counting 8 Places forwards, towards the Right-hand, from thence you'll come to 23, which ſhews that 15 and 8 are 23; from thence count 6 Places more for the next Figure, and you'll find it come to 29; from thence count 5 Places more forwards, towards the Right-

hand, and you'll find it come to 34; which is the Sum of all the five Figures or Parts taken together, as was found before, when you begun at the Left-hand and went forwards to the Right-hand: Or you may *change* or *vary* the *Order* of the *Figures* in any other manner, thus 8, 9, 6, 5, 6: Or thus, 6, 6, 9, 8, 5, and they will always make the ſame *Sum* or *Total*, as you may eaſily try. You ſhould practiſe ſomething of this Nature till you can readily tell the *Amount* of any *two Figures* or *ſmall Sums* whatever, as ſoon as you ſee them or hear them propos'd, which you will quickly be able to do, it being very eaſy: However, if you are doubtful at any Time, you may try by the *Table* whether you are right or no; and the *Table* you may enlarge as far as you pleaſe.

When there is no *Name* affix'd to the *Numbers* given to be *added together*, they are called *abſtract Numbers*; and when they have a Name appropriated to them, they are called *concrete Numbers*; but the Manner of working in both Caſes is the ſame, as you will ſee by the *Examples* following.

| *Example* 1 | *Example* 2 Houſes. | *Example* 3 Perſons. | *Example* 4 Sheep. | *Example* 5 Pins. |
|---|---|---|---|---|
| 7 | 36 | 234 | 6287 | 92547 |
| 9 | 29 | 567 | 2587 | --176 |
| 6 | 82 | 890 | 1234 | ----9 |
| 2 | 65 | 156 | 5678 | 51476 |
| 8 | 79 | 728 | 9012 | 72300 |
| 1 | 68 | 987 | 3456 | -5216 |
| 5 | 95 | 437 | 7892 | --418 |
| 38 | 454 | 3999 | 36146 | 222142 |

The firſt *Example*, or that ſtanding fartheſt towards the *Left-hand*, is a Row of *ſingle Figures*, which I add together after this Manner, beginning at the Bottom and going upwards: I ſay 5 and 1 is 6, and 8 is 14, and 2 is 16, and 6 is 22, and 9 is 31, and 7 is 38. Now as there is but *one Row* of *Figures*, I ſet down 38 for the *Total* or *Amount* of the Whole; and to know whether I am right, I begin at the Top and deſcend gradually, Figure by Figure, ſaying thus, 7 and 9 is 16, and 6 is 22, and 2 is 24, and 8 is 32, and 1 is 33, and 5 is 38, which ſhews the *Total* to be the ſame as before; from whence I conclude I have truly added the Parts together, and that 38 is the Sum or Total of the particular Lines or Figures given; or you may ſet the ſame *Figures* in

any other *Order*, and they will always amount to the ſame *Total*, as was noted before: Now theſe are called *abſtract Numbers*, not having any particular Appellation, but you may call them *Yards*, *Miles*, *Feet*, *Tons*, *Pounds*, *Gallons*, or whatever you pleaſe, and the Work will be always the ſame; as appears by the 2d, 3d, 4th, and 5th *Examples* following. Where in the ſecond *Example* 'tis *ſuppoſed there are ſeven Streets in a Pariſh, and that the firſt had* 36 *Houſes, the ſecond* 29, *the third* 82, *the fourth* 65, *the fifth* 79, *the ſixth* 68, *and the ſeventh* 95, *How many Houſes are in the whole Pariſh?* Firſt ſet down the *Numbers* one under another, either in the Order as you ſee them, in the *Example* before you, or in any other Order, provided you ſet down the ſame *Numbers*, and mind always to keep the *Units* under the *Units*, and the *Tens* under the *Tens*, &c. This done, draw a Line under the Figures ſo ſet down, and begin at the Bottom, and go upwards, ſaying, 5 and 8 is 13, and 9 is 22, and 5 is 27, and 2 is 29, and 9 is 38, and 6 is 44: Here I have 4 Units, which I ſet under the Firſt or Units Place, and add or carry the 4 Tens to 9, the firſt Figure in the ſecond Row, or Row of Tens, ſaying, 4 and 9 is 13, and 6 is 19, and 7 is 26, and 6 is 32, and 8 is 40, and 2 is 42, and 3 is 45, which I ſet down, the 5 under the ſecond Row, or Figure of 9, and the 4 one Figure backwarder or more towards the *Left-hand*, becauſe the laſt *Total* 45 is 45 *Tens*, which is 450; but as there is already a Figure in the *Units Place*, viz. 4, I only ſet down the 45, and find the whole *Amount* or *Total* to be 454, which is the *Number* of *Houſes* in the *Pariſh*: As you may prove by beginning at the Top and going downwards, thus, 6 and 9 is 15, and 2 is 17, and 5 is 22, and 9 is 31, and 8 is 39, and 5 is 44; ſet down the 4 *Units* under the Place of *Units*, and add or carry up the 4 *Tens*, ſaying, 4 and 3 is 7, and 2 is 9, and 8 is 17, and 6 is 23, and 7 is 30, and 6 is 36, and 9 is 45, as before; ſo that the *Total* is 454 both ways, which ſhews the Work to be right. Here 'twill be proper to take Notice, that in the Addition of all Sums that are of one Denomination, if they conſiſt of ever ſo many Lines, they are always added, and the *Totals* diſpoſed of in the ſame Manner as the *Firſt* or *Units* Line, where the *Totals* or *Amounts* are all ſet down, or only the *Units* ſet down and the *Tens* carried to the next Line towards the *Left-hand*, which Method muſt be continued till all the *Lines*, be they ever ſo many, are gone through; as you ſee done in the *third*, *fourth* and *fifth* Examples following. The Reaſon is, that

every

every *Place* or *Figure* towards the *Left-hand*, is *ten Times* the Value of the ſame *Figure* in the Place next to it, on the *Right-hand*; for which Reaſon you need not regard whether they are *Tens*, *Hundreds*, *Thouſands*, *Millions*, &c. as you will ſee by what follows. Now ſuppoſe again, *That in all the Houſes of the firſt Street, in the* Example *foregoing, there lived* 234 *Perſons; that is, Maſters, Miſtreſſes, Children and Servants, &c. taken together; in the ſecond Street* 567; *in the third Street* 890; *in the fourth Street* 156; *in the fifth Street* 728; *in the ſixth Street* 987, *and in the ſeventh Street* 437; Query, *How many Perſons are in the ſaid Pariſh?* Here, after you have ſet down the Numbers, as in the *Example*, you may begin at the Bottom, ſaying, 7 and 7 is 14, and 8 is 22, and 6 is 28; and as the next Figure is 0, and therefore does neither increaſe or diminiſh, I paſs it over, and go to the next Figure, which is 7, and ſay, 28 and 7 is 35, and 4 is 39: Here I ſet down the 9 and carry the 3, which is 3 *Tens*, to the next *Row*, which is the *Row* of *Tens*, ſaying, 3 that I carry, and 3 is 6, and 8 is 14, and 2 is 16, and 5 is 21, and 9 is 30, and 6 is 36, and 3 is 39: Here I ſet down 9 under the 3, becauſe they are 9 *Tens*, and carry the 3 forward to the next *Row*, becauſe they are *Hundreds*, and ſay, 3 that I carry and 4 is 7, and 9 is 16, and 7 is 23, and 1 is 24, and 8 is 32, and 5 is 37, and 2 is 39: Now theſe being 39 *Hundreds*, I ſet the 9 under the *Hundreds Place*, and the 3, one *Figure* more to the *Left-hand*, and then the Total will conſiſt of 4 Places, which in all amount to 3999, which is the Number of Perſons in the Pariſh; as you may eaſily prove by beginning at the Top and adding downwards, as you have been already ſhewn. ---- The *fourth Example* may be the Number of *Sheep*, that are in Poſſeſſion of *ſeven Graſiers*. Query, How many are there in all? By operating in the ſame Manner, as you was directed in the laſt *Example*, till you have gone through all the Lines, beginning either at the *Top* or the *Bottom*, you will find the Total come to 36146.

But that you may be perfectly inſtructed in the Reaſon of ſetting down the firſt *Figure* of the Amount of each *ſingle Line*, and carrying the *Second* forward to the next *Row*, towards the *Left-hand*, you are to obſerve, 'tis only to ſave Trouble, and not abſolutely neceſſary; for in this fourth *Example*, you may find the Total thus: Firſt, ſee how many *Places* or *Rows* are in the *Example*, which here is 4; therefore I make ſo many Dots, thus, . . . . or ſet down ſo many 0's, to repreſent the *Places*; under which I draw a

Line, as in the *Example* here annexed; then I caſt up the firſt *Line*, and find the Amount to be 36, which I ſet down, the 6 under the *Units Place*, and the 3 under the *Tens*, becauſe the *Number* 36 conſiſts of 3 *Tens* and 6 *Units*: Then I caſt up the ſecond Line as if it ſtood alone; and I find the *Total* of that *Line* to be 41. Now becauſe theſe are all *Tens*, I make another Line, and ſet the 1 under the Place of Tens, and the 4 which is 40 *Tens*, under the Place of *Hundreds*, becauſe 10 *Tens* make *one Hundred*; and conſequently 40 *Tens* are *four Hundreds*. Then I caſt up the 3d Line, and find that Total to be 27. Now theſe being 27 Hundreds, I ſet down in another Line, the 7 under the *third* or *Hundreds Place*, and the 2, which is 20 *Hundreds*, under the 4th or *Thouſands Place*, becauſe 10 *Hundreds* make *one Thouſand*, and conſequently 20 *Hundreds* make *two Thouſand*; then I go on to the *fourth Line*, and in the ſame Manner find the *Total* of that to be 33; and becauſe theſe are *Thouſands*, I ſet one 3 under the *Thouſands Place*, and the other one place more backward towards the *Left-hand*, becauſe it repreſents *Tens of Thouſands*; and filling up the void Spaces with Dots or o's, I add theſe four Lines together, and find the *Amount* to be 36146, as before. And thus you may find the *Total* of any Number of Lines or Figures whatever; only you muſt be very careful to put the *Units* under the *Units*, and the *Tens* under the *Tens*, the *Hundreds* under the *Hundreds*, and the *Thouſands* under the *Thouſands*, &c. as you ſee in the fifth *Example*, where, to prevent Confuſion, you may fill up the void Spaces with Dots or o's, which neither increaſe or diminiſh the Value of the other Figures, but ſerve only to make up the Number of Places any Figure is ſuppos'd or deſign'd to ſtand in; as in the 5th *Example*, the two oo's in the 3d Line, have no other Uſe than to fill up the *Tens* and *Units* Places; and ſo of any other, only you are to Note, that in *whole Numbers* they are always put on the *Right-hand*, to fill up the Number of Places, and to determine the Value of the ſignificant Figures on the *Left-hand*: Now this *fifth Example*, you may ſuppoſe to be ſeven Parcels of *Pins*, and by proceeding in the ſame Manner as you did in the *fourth Example*, you will find the Total to be 222142, which is *two Hundred twenty two Thouſand, one Hundred and forty two.* Thus you may go on with any Number of Sums, be they ever ſo large; as ſuppoſe *I had*

| |
|---|
| 0000 |
| --36 |
| -410 |
| 2700 |
| 33000 |
| 01146 |
| 35... |
| 36146 |

*fifteen*

*fifteen Sacks of Malt, that had the following Numbers of Grains, in each, How many Grains are there in all?*

| | Grains | |
|---|---|---|
| In the firſt Sack | 295068 | |
| ſecond - - - | 316845 | |
| third - - - | 182796 | 1374576 |
| fourth - - - | 278868 | |
| fifth - - - - | 300999 | |
| ſixth - - - - | 341628 | |
| ſeventh - - - | 288977 | |
| eighth - - - | 291234 | 1501714 |
| ninth - - - | 279876 | |
| tenth - - - - | 299999 | |
| eleventh - - | 311122 | |
| twelfth - - - | 300096 | |
| thirteenth - - | 314944 | 1506189 |
| fourteenth - | 296682 | |
| fifteenth - - - | 283345 | |
| The Total is --- | 4382479 | 4382479 |

Here ſetting down all the Sacks, and the Number of Grains in each, you may begin at the Bottom, and ſo go on from Figure to Figure, till you come to the Top, ſetting down the *Units* of each *Total* under the *Line* laſt added, and carrying or adding the Tens to the Line next towards the *Left-hand*, till you have gone thro' all the Lines: Or you may begin at the Top and deſcend gradually to the Bottom, in the ſame Manner. Or (which perhaps may be eaſier) you may break ſuch large *Sums* into *two*, *three*, or more *Parts* at your Pleaſure, and add each *Part* by it ſelf, and then add thoſe particular *Totals* together, and their *Total* will be the *Total* of the *Whole*, according to the foregoing *Axiom*, as appears by the above *Example*, where you have the Work done in one *Sum*, and by three particular *Sums*, the *Total* of whoſe three *Totals* being found, make both the ſame, *viz.* 4,382,479. Or you may add continually only two Lines together, till you have taken in all the Lines given, and 'twill produce the ſame with any other of the Methods here propoſed, and muſt indeed be very eaſy to effect; but will require more Time to perform, upon account of the Multitude of Figures neceſſarily increaſed by the great Number of particular Totals that will ariſe, eſpecially where

the particular Line or Sums are many: However you ſhall ſee one *Example* wrought in this Manner, *viz.* the fourth aforegoing, where the

First Line is 6287 *Sheep*, beginning at the Top.
Second - - - - 2587

8874 Total of the firſt and ſecond Lines.
Third - - - 1234

10108 Total of the 1ſt 2d and 3d Lines.
Fourth - - - 5678

15786 Total of 1ſt, 2d, 3d and 4th Lines.
Fifth - - - - - 9012

24798 Total of 1, 2, 3, 4 and 5 Lines.
Sixth - - - - 3456

28254 Total of 1, 2, 3, 4, 5 and 6 Lines.
Seventh - - - 7892

36146 Total of all the 7 Lines as before.

Thus much may ſuffice to ſhew you how to add any Number of particular Sums or Numbers together, that either have, or have not any particular Name or Denomination aſſign'd them.

There are other Methods us'd for the Proof of *Addition*, but the common one at Schools is as follows: Suppoſe theſe Numbers in the Margin, were given to be added, *viz.* Firſt add up all the *eight Lines*, as has been already taught, which comes to 30373; then ſtrike or part off the *upper Line*, and in the ſame Manner find the *Total* of the remaining *ſeven Lines*, which is 24497; this latter *Total* place exactly under the former *Total*, and draw a Line under it, then add the *upper Line* that was cut off to this latter *Total*, and it produces 30373, the ſame with the firſt *Total*; from whence 'tis concluded the Work is right. I will now ſhew you another *Method*, which ſome Perſons greatly eſteem, tho' I think it ought not univerſally to be made uſe of; but for

| | |
|---|---|
| 5876 | |
| 2793 | |
| 152 | |
| 80 | |
| 9 | |
| 7946 | |
| 8238 | |
| 5279 | |
| 30373 | *firſt Total* |
| 24497 | *ſecond Total* |
| 30373 | *third Total* |

for Variety's ſake, 'tis as follows: Suppoſe the firſt Example, as it conſiſts of but one Line, I ſay 5 and 1 is 6, and 8 is 14; I conſider how much that is above 9, and find it to be 5; rejecting the 9, I go forward with the 5, and ſay, 5 and 2 is 7, and 6 is 13, which is 4 above 9; ſo rejecting the 9, I go on with the 4 to the next Figure, which being 9, I ſkip it, and go with the 4 to the 7, which makes 11; here 9 being rejected, I ſet down the remaining 2 by it ſelf, and then I go to the Total of the ſaid Figures, which was before found, and add the Figures of which it conſiſts together, which are 3 and 8, whoſe Total is 11: Now if you reject 9, the Remainder will be 2, the ſame with the Figure you ſet by itſelf; but this Method is not abſolutely certain, for if by miſtake I had made the *Total* to be 83 inſtead of 38; this *Method* would not diſcover the Error, but it would be eaſily found out by the other Methods of Proof before taught: For which Reaſon, I do not recommend the *Uſe*, tho' I ſhew you the *Manner* of proving your *Work* by this *Method*.

My next Work ſhall be to ſhew you the other Part of *Addition* of whole Numbers, called *Multiplication*, which is only a *Repetition* or continual *Addition* of the ſame Sum or Number, a certain required Number of Times: For the eaſy and ready Performance whereof, the following Table is neceſſary to be got perfectly by Heart, to ſave the Trouble of looking upon it ſo often as the Figure changes, whoſe *Sum* or *Total* you are deſirous of.

*Multipli-*

*Multiplication* TABLE.

| A | | | | | | | | B |
|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 |
| 3 | 6 | 9 | 12 | 15 | 18 | 21 | 24 | 27 |
| 4 | 8 | 12 | 16 | 20 | 24 | 28 | 32 | 36 |
| 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 |
| 6 | 12 | 18 | 24 | 30 | 36 | 42 | 48 | 54 |
| 7 | 14 | 21 | 28 | 35 | 42 | 49 | 56 | 63 |
| 8 | 16 | 24 | 32 | 40 | 48 | 56 | 64 | 72 |
| 9 | 18 | 27 | 36 | 45 | 54 | 63 | 72 | 81 |
| C | | | | | | | | D |

The Uſe of this Table is to find the *Product*, *Total*, or *Amount* of any ſingle Figure, repeated any Number of *Times*, not exceeding *Nine*: As if I wanted to know how much 4 times 7 amounted to, firſt I look for 4 in the *firſt Column* on the *Left-hand*, A, C, and then I look for 7 in the top Line A B, and carrying my Finger from 4 in the firſt Column, till it meet the ſeventh Column, and there I find the Number 28 wrote in that Space or Square, which is the *Product*, *Total* or *Amount* of 4 Times 7; or you may look for 7 in the firſt Column A C, and 4 in the top Line A B, and carry your Finger from 7 in the firſt Column, till it come to the fourth Column, and there you alſo find 28; for 'tis the ſame Thing to ſay 4 Times 7, as to ſay 7 Times 4; as appears by the following *Examples* of *Addition*.

| 4 Times 7 | 7 - - 4<br>7 - - 4<br>7 - - 4<br>7 - - 4<br>- - - 4<br>- - - 4<br>- - - 4 | 7 Times 4 |
|---|---|---|
| Total 28 | 28 | as in the Table. |

In the ſame Manner you will find 9 Times 8, or 8 Times 9, to be 72; and 3 Times 6, or 6 Times 3, to be 18, *&c.* Thus you muſt go backwards and forwards till you are perfectly Maſter of the Product or Total of any two ſingle Figures, which in an Hour or two's Time you may eaſily be; and therefore ſuppoſing you ſo, I ſhall ſhew you ſome Examples wherein the Excellency of performing *Addition* by *Multiplication* conſiſts: As, ſuppoſe I wanted to know how many 4 Times 960 amounted to. In this, and all other Caſes, you are to obſerve

obſerve, that there are always *two Numbers* given to find a *Third*, which *Third*, when the *Operation* is perform'd by *Multiplication*, is called the *Product*; but when 'tis done by *Addition*, is called the *Total*, *Sum*, *Amount*, or *Aggregate*; but whether the Work is done by *Addition* or *Multiplication*, the *Total* or *Product* is always the ſame, and is only a Repetition of one of the given Numbers, ſo often as there are *Units* in the other: And for Diſtinction ſake, that Number or Sum that ſtands ſtill, and has the Work performed upon it, is called the *Multiplicand*; and the other which operates, or does the Work, is called the *Mutiplier*. Now either of the given Numbers may be the *Multiplicand*, or the *Mutiplier*, for the Product will always be the ſame, as you ſhall ſee hereafter; but for Conveniency or Expedition ſake, 'tis common to make the largeſt Number, when there is any Difference, the *Multiplicand*, and the ſmaller Number, the *Multiplier*. Theſe Matters premiſed, now to the Queſtion:

| First, by *Multiplication*. | Secondly, by *Addition*. | |
|---|---|---|
| Here I make 960 the *Mutiplicand* | 960 | |
| and 4 the *Multiplier* | 960 | Being ſet down |
| | 960 | four Times. |
| Then 3840 will be the *Product* | 960 | |
| | 3840 | will be the Total, |

which is the ſame with the other.

*Explanation* 960 being the largeſt Number, I make that the *ſtanding Number* or *Multiplicand*, and 4, the *working Number* or *Multiplier*, ſaying, 4 Times 0 is 0, therefore I ſet down 0 under the *Units Place*, and go on to the next Figure, ſaying, 4 Times 6 is 24: Here, as before in *Addition*, I ſet down 4 under the ſecond *Figure* or Place of *Tens*, and carry the 2, ſaying, 4 Times 9 is 36, and 2 is 38; and there being now no more Figures to be multiply'd, I ſet down the 8 under the 9, or Place of Hundreds, and the 3 one place more towards the Left-hand; and ſo I have 3840 for the Product, which appears to be the true Amount, by performing the ſame Work by *Addition*; for having ſet down the 960 four Times, and added the ſeveral Lines together, the *Total* is 3840, the ſame with the *Product*. Now theſe Numbers or Sums given and produced, not having any particular Name apply'd to them, may repreſent any Number of Things they are applicable to: As for Inſtance, there are 960 *Farthings* in one Pound *Sterling*, or *Engliſh Money*; conſequently

3840, are the *Farthings* in 4 *Pounds*; and ſo of any other Species or Thing.

How much is 8 Times 63?

Here I make 63 the *Multiplicand*
and 8 the *Multiplier*

ſo 504 will be the Product.

Having ſet the given Numbers down, one under the other, I ſay 8 Times 3 is 24; here I ſet down 4 under the Units Place, and carry the 2 in my Mind, and go on and ſay, 8 Times 6 is 48, and 2 I carry'd is 50, which being ſet down to the Figure 4, already ſet down, makes the Whole 504; the Truth of which may be try'd, by ſetting down the 63 eight Times, and adding up the two Lines, as before taught, and you will find the *Total* to be 504 alſo. Now this *Example* may be apply'd to any Buſineſs or Matter, circumſtanced with the like Numbers: As, ſuppoſe I wanted to know how many Pints of Wine were in a Hogſhead; by examining into the Tables of Weights and Meaſures, I find that 63 Gallons is one Hogſhead of Wine, and that 8 Pints are one Gallon; ſo that there are 504 Pints in one Hogſhead, or there are 504 Gallons in 8 Hogſheads; and ſo of any Thing elſe. --- Again, ſuppoſe I wanted to know how much 7 Times 8766 amounted to:

Here I make 8766 the *Multiplicand*
and 7 the *Multiplier*

and find 61362 is the Product.

For having put down the Numbers, as above, I begin and ſay, 7 Times 6 is 42: Here I ſet down 2, and carry 4 in Mind; then I go to the next Figure on the Left-hand, and ſay again, 7 Times 6 is 42, and 4 I carried is 46: Here I ſet down 6 in the ſecond Place, and carry 4 in Mind, to be added to the Product of the third Place; there I ſay 7 Times 7 is 49, and 4 is 53: Here I ſet down 3 and carry 5; then I ſay, 7 Times 8 is 56, and 5 is 61: No more Figures being to be multiply'd, I ſet down 61 to the other 3 Figures that are already found, and they make 61362 all together for the *Product*; as you may find by ſetting down 8766 ſeven Times, and adding them together, you will find the *Total* to be the ſame, *viz.* 61362, which will repreſent any Number of Things, agreeable to the Conditions of the *Multiplicand* and *Multiplier*: As for Inſtance, there are 8766 Minutes in a common Year, and conſequently 61362 Minutes in 7 Years. Again, if I aſk how much come 9 Times 63360 to?

Here

Here I make 63360 the *Multiplicand* } the two given
and 9 the *Multiplier* } Numbers.

Here I find 570240 will be the *Product*; for having ſet down the Numbers as you ſee, I begin, ſaying, 9 Times 0 is 0, then 9 Times 6 is 54; here I ſet down 4 under the 6, or ſecond Place, and carry 5; then I ſay, 9 Times 3 is 27, and 5 is 32; here I ſet down 2 under the firſt 3, or 3d Place and carry 3; then I ſay 9 Times 3 is 27, and 3 is 30; here I ſet down 0 under the ſecond 3, or 4th Place, and carry 3; then I ſay 9 Times 6 is 54, and 3 is 57; and as there are no more Figures to be multiply'd, I ſet down 57 to the four Figures already down, and the *Product* is 570, 240, as you may try by ſetting down 63360 nine Times, and adding them together, and you will find the *Total* to be the ſame; which may in like Manner be applied to any particular Name the given Numbers will agree with; as in this *Example*, 63360 are the *Inches* in a *Statute* or meaſured *Mile* of *England*; and conſequently there are 570240 *Inches* in 9 ſuch Miles. If I multiply 567891234 by 2, 3, 4, 5, 6, 7, 8, 9: What will be the ſeveral Products? Here I ſet down the greateſt Number, or

| | |
|---|---|
| *Multiplicand* 567891234 | In like Manner 567891234 |
| under it the firſt *Mutiplier* 2 | being *multiply'd* by 6 |
| whoſe *Product* is 1135782468 | the *Product* is 3407347404 |
| then the ſame multiplied by 3 | when the *Multiplier* is 7 |
| the *Product* is 1703673702 | the *Prod.* will be 3975238638 |
| when you multip. the *Multip.* by 4 | the *Multiplier* being 8 |
| the *Product* is 2271564936 | the *Product* is 4543129872 |
| and when the *Multiplier* is 5 | ſo when the *Multiplier* is 9 |
| the *Product* is 2839456170 | the *Product* is 5111021106 |

Now I preſume you have a ſufficient Number of Examples of one Figure, from whence you may eaſily perceive the Advantage of working by *Multiplication* before that of *Addition*, in reſpect to Conciſeneſs, and Expedition. Now you ſhall ſee how much more the Advantage increaſes, as the *Multiplicand* is to be repeated a greater Number of Times: As, ſuppoſe, I wanted to know how many *Inches* were in five hundred *Miles*; here

I have nothing more to do but to ſet down the *Inches* in one *Mile* for the *Multiplicand*, which is 63360, as in the former *Example*; and for the *Multiplier* 500

the *Product* will be 31,680,000 *Inches* in 500 Miles.

For as 0 neither increaſes nor diminiſhes, but only ſupplies or fills up Places, to make the ſignificant Figures have their due Value; in this *Example* I put down 00 to ſupply the Places of *Units* and *Tens*, and then begin with the 5, and ſay, 5 Times 0 in the *Multiplicand*, is 0, which muſt be put in the third Place; then 5 Times 6 is 30; here being only an 0 and 3 *Tens*, I put down the 0 again, having now 4 of them, and carry the 3, ſaying, 5 Times 3 is 15, and 3 is 18, I ſet down 8 and carry 1; and then ſay again, 5 Times 3 is 15, and 1 is 16, I ſet down 6 and carry 1; then I ſay, 5 Times 6 is 30, and 1 is 31, which I ſet down, no more Figures being to be multiply'd, and the whole *Produce* is 31,680,000 *Inches* in 500 *Miles*. Now by *common Addition* the *Inches* in one Mile, which are 63360, muſt be ſet down 500 Times, and then added together, which if truly done, the *Total* would be 31,680,000; but how tedious, perplexing and ſubject to Error this Method would be, any one may eaſily judge, and proportionably, much more ſo, if the *Multiplier* was 50,000, becauſe under all ſuch Circumſtances the Operation would be done in one Line by *Multiplication*, and conſequently in one or two Minutes Time, which might be ſo circumſtanced, that a Man's Life cannot be long enough to perform it by *common Addition*; though I will ſhew you ſome Methods of ſhortning the Labour of it, by and by. And now, I think, I have been ſufficiently large upon any poſſible Caſe with one Figure; and therefore will proceed to give you ſome *Examples* of more *Figures* than one. As what comes 586 to, when multiply'd by 23? Here having ſet down the biggeſt Number uppermoſt, and the leſſer under it, I *multiply* with the 3, as though it was a ſingle Figure, and find the *Product* to be 1758. Now the 2 being 2 *Tens* or *Twenty*, and virtually has a Cypher prefixed before it, though as 'tis compounded

| | | |
|---|---|---|
| Firſt ſet down | 586 | for the *Multiplicand* |
| and then | 23 | for the *Multiplier* |
| | 1758 | |
| | 11720 | |
| and 13478 will be the *Product*. | | |

pounded with 3, to make up the Number 23, 'tis not expreſs'd, I put an o or Dot . to ſupply the Place of *Units*, and then go on with the 2, as though it were a ſingle Figure, and find that Product to be 11720: Theſe two *Numbers* or ſingle *Products* being added together, produce 13478, for the whole *Product* or *Anſwer* to the *Queſtion*; which let be ſuppos'd to repreſent a *Ship's-Crew*, conſiſting of 586 Men, who having taken a Prize at Sea, the Owners offer 23 *Dollars* per Man to have it again, without being plunder'd. *Query*, What was the whole *Amount*, or how much did they pay for the Redemption of the ſaid *Ship*? *Anſw.* 13478 *Dollars*. Or you may ſuppoſe there was 23 Purſes with 586 Guineas in each; and the Whole will be 13,478 Guineas, *&c.* Or you may ſuppoſe there was 23 *Casks* or *Hogſheads*, that held each of them 586 Pounds of *Sugar*, *Tobacco*, *Rice*, &c. then the Whole will be 13,478 Pounds of *Sugar*, *Tobacco*, *Rice*, &c. Again, ſuppoſe I aſk'd what 69 Times 8766 comes to? Here I multiply the biggeſt Number by the leaſt,

```
   69
 -----
 78894
52596.
-------
```

and find 604854 to be the *Product*, which may be conſidered as the *Anſwer* to the following *Queſtion*, viz. *If a Man be 69 Years old, How many Minutes hath he lived?* At a former Queſtion, 'twas allow'd that 8766 *Minutes* were in one *Year*, and conſequently 604,854 will be in 69 Years; for the Product of every *Multiplication*, great or ſmall, is a Repetition of the *Multiplicand*, ſo often as there are *Units* in the *Multiplier*; and the Name affix'd being wholly arbitrary, it may be as well *Time*, as *Meaſure*, *Money*, as *Corn*, &c. I will now give you ſome *Examples* of 3, 4, 5, 6, and more Figures, *viz.*

*Example* 4.

```
Multiply  57984632
by          829
----------------
 521861688
 115969264.
 463877056..
----------------
48069259928
```

*Example* 5.

```
Multiply   905068
by           4567
-----------------
   6335476
  5430408.
 4525340..
3620272...
-----------------
4133445556
```

*Example*

*Example* 6.

Multiply 1234567
by 54321

1234567
2469134.
3703701..
4938268...
6172835....

67062914007

*Example* 7.

Multiply 981726354
by 478596

5890358124
8835537186.
4908631770..
7853810832...
6872084478....
3926905416.....

469850306118984

*Example* 8.

4000092386000075
5642800009999847

28000646702000525
16000369544000300.
32000739088000600..
36000831474000675...
36000831474000675....
36000831474000675.....
36000831474000675.....
3200073908800060000000.....
8000184772000150.....
16000369544000300.....
24000554316000450.....
20000461930000375.....

2257172135572153505586569198852 5

*Example* 9.

5642800009999847
4000092386000075

28214000049999235
39499600069998929.
33856800059999082 0000..
45142400079998776.....
16928400029999541 .....
11285600019999694.....
50785200089998623.....
22571200039999388 0000.....

2257172135572153505586569198852 5

$8 \times 8$ (1 / 1)

*Of*

## *Of the Proof of* MULTIPLICATION.

In all *Arithmetical Operations* or *Calculations*, the Truth or Certainty of the Work, is as neceſſary to be known as the Manner of doing the Work itſelf; for which purpoſe diverſe Methods have been deviſed, recommended, and us'd; ſome for their Eaſe and Expedition, and others for their abſolute Certainty: Some of theſe Methods are as follows. Suppoſe I wanted to know whether 31,680,000 be the true *Product* of 63,360, multiply'd by 500, as 'tis ſaid to be in Page 20. The common Method us'd in Schools is thus: *Add the Figures of the* Multiplicand 63360 *together, and they make* 18, *add theſe two Figures* 1 *and* 8, *which compoſe the Total* 18 *together, and they make* 9; *then having firſt made a* + *or a large* X, *I ſet down an* 0 *or Cypher, on the Left-hand ſide of the* X, *becauſe all the* 9's *in the laſt Total are to be rejected, and only the Figure, under or over* 9, *are to be ſet down thus,* 0X; *then I go to the* Multiplier, *and there being but one ſignificant Figure,* viz. 5, *the Total will be* 5, *which being leſs than* 9, *I ſet it down on the Right-hand of the* X, *then they will ſtand thus,* 0X5; *theſe two being multiply'd together,*

0

*the* Product *is* 0, *which I ſet at the Top thus,* 0X5; *then I add the Figures that compoſe the* Product *together,* viz. 31,680,000, *and they make* 18, *which being alſo added together, as above, make* 9; *for which I ſet down* 0 *at the*

0

*Bottom of the* X, *and then the Whole will ſtand thus,* 0X5

0

*which ſhews the Top and Bottom Figure to be alike, from whence 'tis concluded the Work is right.*

In like Manner the *Product* 13,478 of 586, multiply'd by 23, will be prov'd to be true; for the *Total* of the Figures 586, of the *Multiplicand*, is 19, which two, *viz.* 1 and 9, being added together, the Sum is 10, which is 1 above, or more than 9, which I ſet down on the Left-hand of the X thus, 1X; the Sum of the Figures 23, the *Multiplier* is 5, which being leſs than 9, I ſet down on the Right-hand, overagainſt the 1 thus, 1X5; then I multiply theſe two together, and the *Product* is 5,

which

which being leſs than 9, I ſet at Top thus, $\overset{5}{1 \times 5}$; then I add the Figures of the *Product* together, *viz.* 13,478, and they make 23, which being likewiſe added together make 5, which I put at the Bottom thus; $\underset{5}{\overset{5}{1 \times 5}}$; then looking on it, I find the Top and Bottom Figures to be both alike, *viz.* both 5's; from whence I conclude the Work to be truly perform'd, and the *Product* to be right. So if I wanted to know whether 604854 was the true *Product* of 8766 multiply'd by 69, as mention'd, Page 21. After having done, as before directed, I find the Figures in the Croſs, or X, will ſtand thus, $\overset{0}{0 \times 6}$. So in the next *Example* where 480692599928 is ſaid to be the *Product* of 57984632, multiply'd by 829; the Proof by this Method will be thus $\underset{8}{\overset{8}{8 \times 1}}$: In the next *Example*, where 4567 is the Multiplier, the Proof will be $\underset{4}{\overset{4}{1 \times 4}}$, and in the *Example*, where 54321 is the Multiplier, the Proof will be $\underset{6}{\overset{6}{1 \times 6}}$, and in the next $\underset{0}{\overset{0}{0 \times 3}}$, and in the large one, $\underset{1}{\overset{1}{8 \times 8}}$; from whence 'tis concluded that the ſeveral Products are right; but by this Method you may be greatly deceived, for innumerable other Numbers will anſwer to this Method of Proof, though the Work is entirely falſe: As for Example, in the firſt Example here produced, where 31,680,000 is ſaid to be the true Product of 63,360, multiply'd by 500, becauſe the top and bottom Figures came to 0; whereas if the ſame Figures had ſtood in any other Order, as 86,130,000, or 16,380,000, or 63,180,000, *&c.* the Anſwer would be the ſame. So likewiſe innumerable other *Numbers* greater and leſſer than the true one, may be found out to give the ſame Anſwer,

as 54, 63, 72, 18, 81, *&c.* leſſer than the true *Number* or *Product*: And 671,400,000, *&c.* greater than the true *Number*; and ſo of all the other Examples, or of any others that may be propoſed: There is another Method of proving Multiplication ſimilar to this, *viz.* by dividing the *Multiplicand* and *Multiplier*, each of them by 7, and ſetting down the Remainders, if any, the one on the *Right-hand*, and the other on the *Left-hand* of the *Croſs*; then multiply thoſe Figures together, and if the *Product* is leſs than 7, ſet it down at the Top; but if the Product of theſe two Figures is more than 7, divide it by 7, or take out all the 7's and ſet down only the Remainder; then divide the *Product* by 7, and ſet the Remainder, if any, at the Bottom of the *Croſs*, and if the top and bottom Figures are alike, the Work is ſaid to be *right*, otherwiſe not; but this Method is liable to the ſame Objections with the proving the Work by caſting out the *Nines* as above, and is alſo more troubleſome to perform, therefore I ſhall ſay no more of it; nor would I recommend either of the Ways for the Reaſons already mention'd: Indeed this latter one by 7, cannot properly come in here, becauſe it takes for granted, that the Perſon who uſes it, has ſome Skill in *Diviſion*, which I do not ſuppoſe; and though almoſt all Authors are of Opinion that *Diviſion* is the beſt *Proof* of *Multiplication*, yet I am very ſure they are much miſtaken, as I could eaſily demonſtrate; for *Diviſion* is much more tedious and operoſe, and conſequently more liable to Errors and Miſtakes from its own Nature, which is much more compounded than *Multiplication*; therefore I will ſhew you how to prove this *Rule* infallibly by itſelf. Let us take the Example above, *viz.* 63,360 multiply'd by 500; here you may ſet down the Multiplicand, and under it the Multiplier, and work as before:

| | | |
|---|---|---|
| Or thus, | 63360 | 63360 |
| | 500 | 500 |
| | 31130000 | 30000 |
| | 0055.... | 15.... |
| | 31680000 | 15..... |
| | | 30..... |
| | | 31680000 |

Here I multiply each ſingle Figure of the *Multiplicand* by the ſignificant Figure of the *Multiplier*, and ſet down its whole *Product* in a Line by itſelf, regarding only the due

placing of the Figures, in reſpect to their Order, *viz.* whether they be *Thouſands*, Tens of *Thouſands*, &c. and this very naturally preſents itſelf; for as the Figures go gradually towards the Left-hand one Place, and ſo increaſe their Value by a tenfold Proportion, the ſeveral *Products* ariſing by their *Multiplication*, muſt do the ſame, as you ſee by the two Methods in which this Example is expreſſed, and the Reſult or Product is the ſame with that in Page 20; from whence you may conclude the Work is right: Or you may ſet down the *Multiplicand* five Times, and add them together, and the *Total* will come to the ſame, if you add two 0's or *Cyphers* to it, for the two 0's or *Cyphers* that ſtood before the *Multiplier*, to make it five Hundred inſtead of 5, as appears by the *Example* in the Margin, where five Times 63,360 comes to 316,800, which having two 0's added to it, makes the ſignificant Figures be increaſed in Value an hundred Times; ſo that inſtead of 316,800, it is 31,680,000, as before; from whence it may be concluded the *Product* was right. In this, and all other Caſes, if the *Multiplier* is the *Product* of any two or more Numbers, little or big, if you *multiply* the *Multiplicand* by thoſe Numbers continually, the Product will be the ſame as when you multiply by the common Method, which may be another Method of Proof, whoſe certainty may be depended on: Or if you want 1, 2, 3, *&c.* you may add the *Multiplicand* ſo many Times to the laſt *Product* of the compoſing Numbers, and that *Total* will come to the ſame with the common Product: As in this Caſe before us, 500 being the Multiplier, I need only regard the 5, and add two Cyphers or 0's to the *Total* or *Product*, and the Work will be the ſame: As for Inſtance, 2 Times 2 is 4; here I ſet down the *Multiplicand* 63360 and multiply it by 2

63,360
63,360
63,360
63,360
63,360
316,800
Add two 00's
31,680,000

The *Product* 126720 is twice 63,360 the *Multiplicand*; then *multiply* again by 2

and the *Product* 253440 is twice twice or 4 Times 63,360; to which *add* 63360 or the *Multiplicand* once,

and the *Total* 316800 is 5 Times 63,360; to which add two 0's and it will be 316,8000,000, the former *Product*.

Or you may make 500 the *Multiplicand*
and 63,360 the *Multiplier*,

30000
1500..
1500...
3000....

and the *Product* will be 31680000, as before.

From all which different Methods you will always find the ſame *Reſult*, *Total* or *Product*, if your Work be right; and if at any Time there is any Difference, you may be ſure there is an Error ſomewhere, which you muſt find out before you leave it. I have been very full upon this Example, on purpoſe that you may the more eaſily underſtand what follows. The ſecond *Example* ſhall be

586 multiply'd by 23, which I'll do
thus: Set down 23 under the ſaid *Multiplicand* 586:

Here you ſee I multiply each Figure in the *Multiplicand*, by each Figure in the *Multiplier*, and ſet down the whole Product of each, without carrying any thing, regarding only the Order of Places; which being done, and the ſeveral *Products* collected into one *Total*, I find it to be 13,478, as before in Page 20.

1218
..54.
1112.
.06..
13478

Or make 23 the *Multiplicand*,
and 586 the *Multiplier*

138
184.
115..

and 13478 will be the Product, which is the ſame with either of the former Methods; or you may do thus:

Multiply 586
by 7

and the Product is 4102
then this by 3

and the Product is 12306
to this add 586
twice 586

and the Total is 13478

Here the *Multiplicand* 586 is multiply'd by 7, and conſequently the *Product* 4102, is ſeven Times 586; then this multiplied by 3, makes 12,306, which is 3 Times 7, or 21 Times 586; but I want 23 Times 586, therefore I add twice 586 to 12306, and it makes 13,478; or 23 Times 586, as before.

In like manner if you multiply 8766 by 69 Or 69 by 8766

| | |
|---|---|
| | 414 |
| | 414. |
| | 483.. |
| | 552... |
| Here the *Product* is | 604854 as before in Page 21. |

| | |
|---|---|
| | 8766 |
| by | 69 |
| | .76554 |
| | ..234. |
| | .4336. |
| | 4826.. |
| | 604854 |

This being done in the same Manner as you did the last *Example*, Page 27, you will find the *Product* come to the same, as in Page 21, by the other Method, as appears by the *Example* here annexed.

The fourth *Example* 829 by 57984632

| | |
|---|---|
| The Reverse of this Example is in Page 21. | 1658 |
| | 2487. |
| | 4974.. |
| | 3316... |
| | 6632.... |
| | 7461..... |
| | 5803..... |
| | 4145..... |
| | 48069259928 |

Fifth *Example* 4567 by 905068

| | |
|---|---|
| | 36536 |
| | 27402. |
| | 27835... |
| | 41103..... |
| | $413843555^{6}$ |

See Page 21.

Thus you may prove any Sum in *Multiplication* whatever, by changing the *Multiplicand* into the *Multiplier*; and if the *Product* comes out the same with the first, you may be sure the Work is right in both, otherwise not; for in this Method no possible Trick or Artifice can be us'd to make it otherwise, without knowing you have committed a Fault, at least, in one of the *Operations*; the 8th and 9th *Examples* in the large Numbers are a further Proof of the Certainty of this Method. I shall only add sundry *Examples* more, with their *Products*, for your Practice, by operating of which, you will find your self render'd perfect in this Rule, and ready to execute any Thing that can be proposed in *plain* or *whole* Numbers.

1. *What is the Product of* 8650652672, *multiply'd by* 46875? Ans. 405,499,344,000,000.

2. *What is the Product of* 79278509, *multiply'd by* 362179? Ans. 28,713,011,111,111.

3. *What*

3. *What is the Product of* 634070839, *multiply'd by* 735200839? Anſ. 46,616,950,222,222,222.

4. *What is the Product of* 981237645, *multiply'd by* 546732189? Anſ. 536,474,205,580,054,905.

5. *What is the Product of* 546732189, *multiply'd by* 981237645? Anſ. 536,474,205,580,054,905.

I ſhall now go on to ſhew you the *Addition* and *Multiplication* of *Sums* or *Numbers* of diverſe *Denominations*; and firſt of all, as is uſual, the *Addition* of *Money*, or the *common Coin* current among us, where you are firſt to take Notice that, 4 *Farthings make, or are contained in one Penny*; 12 *Pence, make, or are contained in* 1 *Shilling*; *and* 20 *Shillings make, or are contained in* 1 *Pound.* Tho' we have no Piece of *Coin* or *Money* of twenty Shillings, or one Pound Value; yet all thoſe we have, whether *Gold*, *Silver* or *Copper*, are rated or valued by the *Pound*, or rather by the *Shilling*, which is the twentieth Part of a *Pound*; for in *Gold*, we have now in common uſe only the *Guinea*, valued at 21 *Shillings* or *one Pound one Shilling*; and the *Half-Guinea*, valued at *ten Shillings* and *Six-pence*; there are indeed *double Guineas*, valued at *two Pounds* and *two Shillings*; and *five Guinea-pieces*, valued at *five Pounds* and *five Shillings*; but theſe are very ſcarce, and may rather be call'd *Medals* than *common Coin*. The *Silver* is coined into *Crowns* or *five Shilling-pieces*, *half Crowns*, or *two Shillings* and *Six-penny-pieces*, *Shillings*, *Six-pences*, *Groats*, *Three-pences*, *Two-pences*, and *Pennys*; but the leſſer Pieces, or thoſe under *Six-pence*, are now but ſeldom current. Since the coining *Copper-half-pence* and *Farthings*, which of late Years have been coined very plentifully for their great Uſefulneſs, in the more eaſy and ready changing the Silver-Coins, where odd Pence are concerned in the Price or Value of any Commodity, the getting by Heart the following *Table*, which is commonly called the *Pence-Table*, will be abſolutely neceſſary, for all ſuch as deſire to be ready in caſting up any Sums of Money, either great or ſmall; and therefore I earneſtly recommend that Labour to you.

## *The* PENCE-TABLE.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20 | Pence | is | 1 | Shilling | and | 8 | Pence |
| 30 | Pence | | 2 | Shillings | and | 6 | Pence |
| 40 | - - | | 3 | - - - | | 4 | *&c.* |
| 50 | - - | | 4 | - - - | | 2 | |
| 60 | - - | | 5 | - - - | | - | |
| 70 | - - | | 5 | - - - | | 10 | |
| 80 | - - | | 6 | - - - | | 8 | |
| 90 | - - | | 7 | - - - | | 6 | |
| 100 | - - | | 8 | - - - | | 4 | |
| 110 | - - | | 9 | - - - | | 2 | |
| 120 | - - | | 10 | - - - | | - | |
| 130 | - - | | 10 | - - - | | 10 | |
| 140 | - - | | 11 | - - - | | 8 | |
| 150 | - - | | 12 | - - - | | 6 | |
| 160 | - - | | 13 | - - - | | 4 | |
| 170 | - - | | 14 | - - - | | 2 | |
| 180 | - - | | 15 | - - - | | - | |
| 190 | - - | | 15 | - - - | | 10 | |
| 200 | - - | | 16 | - - - | | 8 | |
| 210 | - - | | 17 | - - - | | 6 | |
| 220 | - - | | 18 | - - - | | 4 | |
| 230 | - - | | 19 | - - - | | 2 | |
| 240 | - - | | 20 | - - - | | -- | |

Some rather chuſe this Form.

| | | | |
|---|---|---|---|
| 1 | Shilling | is | 12 Pence |
| 2 | Shillings | is | 24 Pence |
| 3 | *&c.* - - | | 36 *&c.* |
| 4 | - - - | | 48 |
| 5 | - - - | | 60 |
| 6 | - - - | | 72 |
| 7 | - - - | | 84 |
| 8 | - - - | | 96 |
| 9 | - - - | | 108 |
| 10 | - - - | | 120 |
| 11 | - - - | | 132 |
| 12 | - - - | | 144 |
| 13 | - - - | | 156 |
| 14 | - - - | | 168 |
| 15 | - - - | | 180 |
| 16 | - - - | | 192 |
| 17 | - - - | | 204 |
| 18 | - - - | | 216 |
| 19 | - - - | | 228 |
| 20 | - - - | | 240 |

The Uſe of this *Table*, is to know how many *Shillings*, &c. are contained in any Number of *Pence*, from 20 to 240, or how many *Pence* are in any Number of *Shillings*, from 1 to 20, and the Contrary.

*Now we will ſuppoſe the following Particulars to be what a Servant-Maid may have laid out for her Maſter or Miſtreſs*, viz.

| | | *Pence* | *Farthings.* |
|---|---|---|---|
| 26 *Sept.* 1737. | For Small-Coal - - - - - | 2 - - | 2 |
| | For Sand, a Broom, and a Pound of Butter - - | 10 - - | 1 |
| 27 - - | For two Pounds of Stakes | 8 - - | 2 |
| 28 - - | For three Pounds and a half of Mutton - - | 10 - - | 2 |
| 29 - - | For Thread, Tape and Pins | 11 - - | 3 |
| 30 - - | For a Letter, and Hooping a Pail - - - | 9 - - | 2 |

Shills. 4 and 5 Pence. - -

Having

Having made ſome Mark of Diſtinction over the ſeveral Columns, as here I have writ *Pence* and *Farthings*, you muſt always be very careful to keep every Name in its own *Column* or *Rank*, and then add up the *Column* of the leaſt Value firſt; as here I add up the *Farthings*, and they make 12. Now as 4 Farthings are one Penny, by the former Table, called *Multiplication-Table*, which I ſuppoſe you to have by Heart, you know that 3 Times 4 is 12: So that 12 *Farthings* make 3 *Pence* exactly; for which Reaſon I only make a Daſh thus - under the *Column* of *Farthings*, and carry the 3 to the *Column* of *Pence:* And here your beſt Way will be to add up only thoſe Figures that ſtand in the *Units-Place* firſt, as you did in the ſecond *Example* of plain *Addition*, in Page 9, and then the *ſecond Place* or *Tens*, and ſet down how much they come to, upon a Bit of Paper by itſelf, or elſe bear it in Mind, as in this Example; I ſay 3 that I carry from the *Farthings* and 9 is 12, and 1 is 13, and 8 is 20, and 2 is 22; ſet down 2 and carry 2, which being added to the 3 *Tens*, or 1s, that ſtand in the *Tens* Place, makes 5, which being ſet down to, or before the 3 on the *Left-hand*, or in the *ſecond* Place, the whole is 53 Pence. Now the *Table* tells me that 50 *Pence* is 4 *Shillings* and 2 *Pence*, conſequently 53 *Pence* is 4 *Shillings* and 5 *Pence*. *So if the Bill was a little larger: As ſuppoſe this that follows.*

| *Expences this Week, to* 22 *Octob.* 1737. | *Shill.* | *Pence* | *Far.* |
|---|---|---|---|
| Paid the Waſher-Woman - - - | 5 : | 10 : | 2 |
| Paid the Milk-Woman - - - | 13 : | 10 : | 3 |
| the Baker - - - - | 14 : | 11 : | -- |
| the Butcher - - - - | 19 : | 8 : | -- |
| the Tallow-Chandler - - - | 8 : | 8 : | -- |
| Butter, Eggs and Flower - - | 2 : | 11 : | 2 |
| Gave ſundry poor People - - | 1 : | 9 : | 3 |
| *L.* | 3 : 07 : | 09 : | 2 |

Here the *Farthings* being caſt up, amount to 10, which is *Two-pence* and *Two-farthings* over: I ſet down the Overplus 2 under the *Farthings*, and carry the two whole *Pence* to the *Pence*, and find that *Column* comes to 69; by the *Table* I find that 60 Pence makes 5 *Shillings*, conſequently 69 Pence muſt be 5 *Shillings* and 9 *Pence*; therefore I ſet down 9 under the *Pence*, and carry the 5 *Shillings* to the *Shillings*; and here I add as before directed for the *Pence*, viz. I ſay 5 that I carry and 1 is 6, and 2 is 8, and 8 is 16, and 9 is 25, and

4 is

4 is 29, and 3 is 32, and 5 is 37: I ſet down 7 upon a Bit of Waſte-Paper, and carry the 3, and ſay 3 and 1 is 4, and 1 is 5, and 1 is 6, which being 6 Tens, I halve, by ſaying the Half of 6 is 3, which is 3 *Pounds*, becauſe 2 *Ten Shillings* make 1 *Pound*, conſequently 6 *Ten Shillings* are 3 *Pounds*; ſo that I ſet down the 7 under the Shillings, and carry the 3 *Pounds* a Column further toward the Left-hand, as you ſee in the *Example*, where the *whole Sum*, *Amount* or *Total* of the Bill is *three Pounds ſeven Shillings* and *Nine-pence Half-penny*.

Again, *Expences paid Sundry this Week to* 22 Octob. 1737.

| | *l.* | *s.* | *d.* |
|---|---|---|---|
| Mr. *A. B.* the Carpenter - - | 5 | 16 | 6 |
| *C. D.* the Linen-Draper - - | 8 | 13 | 4 |
| *E. F.* the Milliner - - - | 7 | 19 | |
| *G. H.* the Taylor - - - | 2 | 17 | 8 |
| *I. K.* the Hatter - - - | 5 | 11 | 6 |
| *L. M.* the Brewer - - - | 9 | 15 | 9 |
| *N. O.* the Hoſier - - - | 4 | 12 | |
| *L.* | 45 | 5 | 9 |

Here the Pence amount to 33. I find by the *Table* that thirty *Pence* is two *Shillings* and *Sixpence*; ſo that thirty three *Pence*, being *Three-pence* more, muſt be two *Shillings* and *Nine-pence*; I ſet down the *Nine-pence* under the *Pence*, and carry the two *Shillings* to the *Shillings*, and find the firſt Line of the *Shillings* comes to 35; I ſet down 5 and carry the 3 to the Tens, and find they make 10, which are 10 Times 10 Shillings, the Half of which being 5, are ſo many Pounds, which I carry to the Row of *Pounds*, and adding it up, I find it amounts to 45; and there being but one Row, I ſet down 45, and find the whole Amount or Total is *Forty five Pounds*, *five Shillings* and *Nine-pence*.

Again,

Again; Suppoſe a *Merchant* or *Banker* ſends his *Man* to collect the following *Bills*, viz.

| | *l.* | | | | *s.* | *d.* | *q.* | |
|---|---|---|---|---|---|---|---|---|
| 1ſt for | 7 | 3 | 6 | : | 15 | : 10 | ½ | |
| 2d | 5 | 9 | 8 | : | 18 | : 11 | ¼ | |
| 3d | 9 | 1 | 9 | : | 19 | : 06 | ¾ | |
| 4&c. | - | 5 | 8 | : | 17 | : 09 | ½ | |
| 5 | - | 9 | 5 | : | 16 | : 11 | ¼ | 2410 : 9 : 1¼ |
| 6 | - | 3 | 7 | : | 14 | : 08 | - | |
| 7 | 1 | 5 | 2 | : | 12 | : 04 | - | |
| 8 | - | - | 9 | : | 13 | : 11 | ½ | |
| 9 | - | - | 8 | : | 06 | : 10 | ¼ | |
| 10 | - | 1 | 3 | : | 18 | : 09 | | 222 : 6 : 6¼ |
| | 2 | 6 | 3 | 2 | : 15 | : 08 | - | 2632 : 15 : 8 |
| | 1 | 8 | 9 | 5 | : 19 | : 09 | ½ | |
| | 2 | 6 | 3 | 2 | : 15 | : 08 | - | |

Here you will obſerve, that the *Farthings* are put down in a different Manner to what they were in the former *Examples*, viz. ¼ is one *Farthing*; ½ is two *Farthings* or an *Half-penny*; ¾ is three *Farthings*, which are to be added together in the ſame Manner as they were before. As in this *Example*. I begin at the Bottom, and ſay 1 and 2 is 3, and 1 is 4, and 2 is 6, and 3 is 9, and 1 is 10, and 2 is 12 *Farthings*; which being 3 *Pence*, I make a Stroke thus -- under the *Column* of *Farthings*, and carry the 3 to the *Column* of *Pence*, and add as before directed, and find the *Pence* come to 92, which is 7 *Shillings* and 8 *Pence*; wherefore I ſet down the 8 odd *Pence*, under the *Column* of *Pence*, and carry the 7 *Shillings* to the *Shillings*, and find the firſt *Row* comes to 65; for which I ſet down 5, and carry ix to the next Row, and find that comes to 15. Now his being an odd Number, I ſet down 1 to the 5 before ſet own, and it makes 15, which 1 being abated out of he 15, the whole Amount of the Row, the Reſidue, which s 14, I halve, and carry its Half, which is 7, to the firſt *Row* of the *Pounds*, which amounting to 72, I ſet down 2 nder the *Units Place*, and carry the 7 to the next Line, which amounts to 43; for which I ſet down 3 under the *Tens* Place, and carry the 4 to the third *Row*, and find that

amounts to 26; and as there are no more *Rows* of *Figures* to be added, I ſet down 26 to the 23 already ſet down, and the Whole makes 2632 *Pounds* 15 *Shillings* and 8 *Pence*; for the Proof of which you may begin at the Top, and add downwards, and you will find the Amount to be the ſame: Or you may part it into two Parts, and find the Amount of each, and then add thoſe two *Totals* together, and you'll find them come to the ſame; as you may ſee done by the *Example* above, where you ſee it parted into two five Lines; the

| | |
|---|---|
| Amount of the uppermoſt 5 *Lines* is | *L.* 2410 : 9 : 1½ |
| and the Amount of the undermoſt 5 *Lines* is - - - - - - - - | *L.* 222 : 6 : 6½ |
| The Total whereof is - | *L.* 2632 : 15 : 8 |

as before, when the whole ten Lines were added at once. The common *Method* in *Schools* is to add up the Whole, and ſet down that Total *L.*2632 : 15 : 08

then to draw a *Line* under the uppermoſt *Line*, and add all under that *Line* together, which in this *Example* amounts to - - - *L.* 1895 : 19 : 09½

Then this laſt *Total* being added to the uppermoſt Line makes as before *L.* 2632 : 15 : 08

By the foregoing *Method* any Number of particular *Sums* of *Money* may be truly and expeditiouſly added together into one *Total*. Yet ſome think the following Method eaſier and propereſt for thoſe who are not frequently practiſing ſuch like *Operations*, viz. to begin and add the loweſt Species together, and to make a Point thus . or thus * every Time the Sum of the leſſer *Species* is equal to, or greater than one of the next ſuperior *Species*; as in the laſt *Example*, begin at the Bottom, and ſay 1 and 2 is 3, and 1 is 4, which being 4 *Farthings*, I make a Prick or Dot, as you ſee in the *Example*. Then, as there is no Overplus to be carried forward to the next Figure, I go on and ſay, 2 and 3 is 5; which being 5 *Farthings*, is 1 *Penny*, and 1 *Farthing* over; I make a Dot at the 3 *Farthings*, as you ſee in the *Example*, and carry the 1 *Farthing*, which is over, to the next *Figure*; and ſay 1 that I carry, and 1 is 2, and 2 is 4, which being alſo 4 *Farthings*, which are equal to one *Penny*, I make another Dot at the uppermoſt 2. And now all being added together, and no Overplus remaining, I make a Daſh thus — under the *Column* of *Farthings*; then I count how many Dots there are in all, and I find 3, which repreſents 3

*Pence*

*Pence*, which 3 *Pence* I carry to the *Column* of *Pence*, and ſay, 3 I carry and 9 is 12. Now 12 *Pence* being exactly a *Shilling*, I make a Dot at the 9, and carry nothing forwards becauſe there was no Overplus *Pence*; but go on afreſh, ſaying, 10 and 11 are 21. Now by the foregoing *Table*, I know that 20 *Pence*, are one *Shilling* and 8 *Pence*, conſequently 21 *Pence* is one *Penny* more, *viz.* 1 *Shilling* and *Nine-pence*; for which Reaſon I make a Dot at the *Eleven-pence*, and carry the 9 Overplus *Pence* to the next Number of *Pence*, viz. 4, and ſay 9 and 4 is 13; and by the aforeſaid *Table* I find that 12 *Pence* is 1 *Shilling*; ſo that 13 Pence is 1 *Shilling* and 1 *Penny* over: I make another Dot at the 4, and carry the Overplus 1 to the next *Sum* of *Pence*, and ſay 1 and 8 is 9, which being leſs than a *Shilling*, I go forward and add 9 to the next Sum, *viz.* 11, and it makes 20 *Pence*; which being 1 *Shilling* and 8 *Pence*, I make another Dot at the 11, and carry the 8 Overplus *Pence* to the 9, which makes 17; and as 17 *Pence* is 1 *Shilling* and 5 *Pence*, I make another Dot at the 9, and carry the 5 to the 6; and that making 11 *Pence*, which being leſs than a *Shilling*, I go forward and add that 11 to the next *Sum*, which being alſo 11, I ſay 11 and 11 is 22 *Pence*, which is 1 *Shilling* and 10 *Pence*; wherefore I make another Dot at that 11, and carry the Overplus 10 to the uppermoſt *Sum* of *Pence*, and it makes 20; which being 1 *Shilling* and 8 *Pence*, I make another Dot at the uppermoſt 10; and becauſe there are no more Sums of *Pence* to add the laſt Overplus 8 to, I ſet down the 8 under the *Column* of *Pence*, then I add or count up the Dots in the *Column* of *Pence*, and find the *Sum* is 7, which ſtands for, or repreſents 7 *Shillings*, which I carry to the next *Column* or the *Row* of *Shillings*, ſaying 7 that I carry and 18 is 25. Now 20 *Shillings* being 1 Pound here is 5 Overplus *Shillings* to be carried to the next Number of *Shillings*; therefore I make a Dot for the *Pound* and go forward, ſaying, 5 and 6 is 11; and this being under a *Pound*, I go on and add that to the 13 above, and that makes 24, which is 1 *Pound* 4 *Shillings*; therefore I make another Dot at the 13, and carry the Overplus 4 forward, ſaying, 4 and 12 is 16, which being leſs than 20, I go forward to the 14, and it makes 30, which is 10 more than 20; ſo I make another Dot at the 14, and carry forward the Overplus 10 to the 16, and that makes 26; here I make another Dot for the *Pound* or 20 *Shillings*, and carry the Overplus 6 to the 17, which makes 23; I make another

ther Dot at the 17, and carry the Overplus 3 to the next Parcel of *Shillings* 19, and it makes 22; I make another Dot at the 19, and carry the Overplus 2 to the next Sum, 18, and it makes juſt 20; therefore I make another Dot at the 18, and carry nothing; and becauſe the next Sum of Shillings, 15, is the laſt, and leſs than 20, I ſet it down as the Overplus, under the *Column* of *Shillings*, as you ſee in the *Example*; then I count the Dots, and find them to be 7, which ſtand for 7 *Pounds*; theſe I carry to the *Units-Row* of the *Pounds*, and add as you have been already taught in the Addition of whole Numbers; or make a Dot at every 10, and carry the Overplus forward: Thus ſay, 7 *Pounds* that I carry from the *Shillings*, and 3 is 10; here I make a Dot and carry nothing forward; then I go on, and ſay, 8 and 9 is 17, which being 1 *Ten* and 7 over, I make a Dot at the 9 and carry the 7 to the 2, and it makes 9, which being leſs than 10, I go on to the 7, and it makes 16; here I make another Dot, and carry 6 to the 5, and it makes 11; I make another Dot, and carry 1 to the 8, which being but 9, I go on and add it to the 9, and the Sum is 18; here I make another Dot, and carry the 8 to the 8, and the *Sum* is 16; I dot again and carry the 6 to the next Figure, which being the laſt, makes 12; I dot again for 10, and the Overplus 2 I ſet down under the *Units* Place, and count the Dots, which amounting to 7, I carry it to the *Row* of *Tens*, ſaying, 7 and 1 is 8, and 5 is 13; here I dot and carry 3, ſaying, 3 and 3 is 6, and 9 is 15; dot again and carry 5, which being added to the next Figure, which is 5, they make 10; here I dot and carry nothing; then go on, ſaying, 1 and 9 is 10; dot again and carry nothing; now there being but 1 Figure more, which is 3, I ſet it down as the Overplus, as you ſee in the *Example*; then I count the Dots, and find their Sum is 4, which I carry to the next Row, or Line of *Hundreds*, ſaying, 4 and 1 is 5, and 9 is 14, dot and carry 4 to the 5, which is 9, and 7 is 16; dot again and ſet down the Overplus 6, becauſe there are no more Figures to be added; then count the Dots, which are 2, and there being no more Lines to be added, ſet down 2, for the 2 Dots, one Place more towards the *Left-hand*, and your Work is done. So will you find the *Whole*, *Total* or *Amount* to be 2632 *Pounds* 15 *Shillings* and 8 *Pence*, as before; and here, as before, you may alſo prove your Work, by beginning at the Top and deſcending gradually to the Bottom, only 'twill be proper to make ſome other Mark inſtead of a Dot, as

* leſt you ſhould miſtake the Dots in Deſcent, for thoſe made in aſcending; for you will frequently find them not to happen in the ſame Place, or at the ſame Figure you had dotted before; as you ſee by the *Example*, where beginning at the Top, I ſay, 2 *Farthings* and 1 is 3, and 3 is 6 *Farthings*, which is 1 Penny and 2 *Farthings*: Here I make a * and carry the 2 to the next 2, which being 4 *Farthings* or 1 *Penny*, I make another *; and having nothing to carry, I go on, ſaying, 1 and 2 is 3, and 1 is 4 *Farthings*, or 1 *Penny*; here I make another *, and all the *Farthings* being added, and no Overplus remaining, I make a Daſh at Bottom under the *Farthings*, as before; then counting the *'s, I find them 3, which I carry to the *Pence*, as I did before the *Dots*, and going to the uppermoſt Figures in the *Column* of *Pence*, I add them to the 10, which makes 13 *Pence* or 1 *Shilling* and 1 *Penny*. I make a *, and carry the Overplus 1 to the 11, and it makes 12 *Pence*; which being juſt 1 *Shilling*, I make another * and carry nothing; then coming downwards, I ſay 6 and 9 is 15 *Pence*, which being 1 *Shilling* and 3 *Pence*, I make another * at the 9, and deſcending add the Overplus 3 to the 11, and it making 14 *Pence*, I make another *, and deſcend with the Overplus 2 to the 8, which making but 10 Pence, and that being leſs than a *Shilling*, I add it to the 4; that making 14 *Pence* or 1 *Shilling* and 2 *Pence*, I make another *, and deſcend with the Overplus 2 to the 11, and their Sum is 13; here I make a * again, and add the Overplus 1 to the 10 below, whoſe Sum 11, being leſs than a *Shilling*, I add it to the laſt Figure 9, and the Sum is 20, which being 1 *Shilling* and 8 *Pence*, I make another * at the 9, and ſet down the Overplus 8, as before; then counting the *'s, I find them 7, with which I go to the uppermoſt Parcel of *Shillings*, ſaying, 7 and 15 is 22 *Shillings*, which being 1 *Pound* 2 *Shillings*, I make a * for the 1 Pound, and deſcend with the 2 Overplus *Shillings*, and add them to the 18, which making juſt 20 *Shillings*, or a *Pound*, I make a * and carry nothing; then deſcending, I ſay, 19 and 17 are 36 *Shillings*, which is 1 *Pound* and 16 *Shillings*, I make another * at 17, and add the 16 Overplus *Shillings* to the 16, and they make 32 *Shillings*; which being 1 *Pound* and 12 *Shillings*, I make another * at the 16, and carry the Overplus 12 to the 14; their Sum being 26 *Shillings*, or 1 *Pound* and 6 *Shillings*, I make another *, and add the Overplus 6 to the 12, whoſe Sum 18 being leſs than a *Pound*, I add it to the 13, and it makes 31 *Shillings*, or 1 *Pound* 11 *Shillings*; here I make another *, and

add

add the Overplus 11 to the 6, and go on with their Sum 17 to the 18, and that makes 35 *Shillings*, which is 1 *Pound* 15 *Shillings*; and now all the Figures being taken in, I make another * at the 18, and ſet down the Overplus 15, under the *Column* of *Shillings*; then I count the *'s, and find their Number is 7, which I carry to the *Units-Row* of the *Pounds*, and deſcend from the Top, ſaying, 7 and 6 is 13. Now, becauſe in the Pounds, and all other whole Numbers, every Row is counted by *Tens*, I make a * and carry 3 to 8, whoſe Sum being 11, I make another *, and carry 1 to 9, whoſe Sum being 10, I again make a *, and carry nothing, then deſcending, I add 8 to 5, which making 13, I make another *, and carry 3 to the next 7 below, whoſe Sum being 10, I make a *, and carry nothing, but deſcending add 2 and 9, whoſe Sum being 11, I make a *, and carry 1 to the 8, whoſe Sum 9 being leſs than 10, I deſcend and add it to the laſt Figure 3, whoſe Sum being 12, I make another *, and ſet down the Overplus 2, as you ſee in the *Example*; then counting the *'s and finding their Sum to be 7, with it I go to the uppermoſt Figure in the ſecond or *Tens* Row, ſaying, 7 and 3 are 10; here I make a *, and having no Overplus to carry, I deſcend, and ſay, 9 and 1 is 10; I make another *, and having nothing to carry, ſtill deſcending, I add 5 to 9, whoſe Sum being 14, I make a * at the 9, and add the Overplus 4 to the next Figure 3, whoſe Sum 7, being leſs than 10, I deſcend and add it to the 5, and it makes 12; here I make another *, and add the Overplus 2, to the laſt Figure 1, and the Sum being but 3, which is leſs than 10, I ſet down under the ſecond *Row* or *Place* of *Tens*, then counting the *'s find them to be 4, with which I go to the uppermoſt Figure in the third *Row* or *Place* of *Hundreds*, and ſay 4 and 7 make 11; here I make a *, and carry 1 to 5, whoſe Sum 6 being leſs than 10, I add it to the next Figure 9 below it, and their Sum being 15, I make another *, and carry the Overplus 5 to the laſt Figure 1, and the Sum 6 being leſs than 10, I ſet it down, then counting the *s, I find their Sum to be 2, and as there are no more *Rows* of *Figures* to be added, I ſet down 2 *one Place* more towards the *Left-hand*, and the whole Sum is 2632 *Pounds* 15 *Shillings* and 8 *Pence*, as before; from whence I conclude that the Work is right.

Having now explained the various Ways by which any *Sum* in *Addition*, properly ſo call'd, may be done; there remains little more to be ſaid upon that Head, but only to

practiſe

practiſe what has been taught, and by various *Examples* to make your ſelf perfect; for which purpoſe I will inſert more Examples wrought by all the foregoing Methods, which I would adviſe the Learner to go over, and alſo to ſet the ſame down in various other Methods or Orders; and if the Work is truly perform'd, the *Total* or *Amount* will always be the ſame, as has been before noted, and as you may obſerve by the following *Example*, which I have varied three different Ways, to make the Matter quite plain to you; and I would adviſe the ſame Practice to be done by other Examples, which in a ſmall Time will render you capable of doing any thing of this Kind with Eaſe, Readineſs, and Certainty: And without ſome ſuch like Application, Expedition and Certainty are not to be acquired. One ſuch *Example* as is here given you, and varied according to different Modes, will be better for your Practice than ſo many different ones, becauſe you may always be ſure of the Truth of your Work, by its agreeing in the whole *Total* with what went before; whereas if you operate Sums whoſe Amounts are abſolutely different from one another, and if you have not a Maſter by you, to inſpect your Work, you may not perhaps be ſo well ſatisfied of the Truth of your own Performance, and therefore will not be ſo proper for your Improvement, as the Method here laid down, which will anſwer all the Ends of duly informing a Learner, till he is ſufficiently ſkill'd, to depend upon his own Judgment.

*Example* 1.

| *l.* | | | | *s.* | *d.* | *q.* |
|---|---|---|---|---|---|---|
| 7 | 5 | 9 | 6 | 18 | 10 | ½ |
| 8 | 2 | 7 | 3 | 12 | 11 | ¾ |
| 5 | 9 | 2 | 8 | 16 | 09 | ¼ |
| 1 | 2 | 3 | 4 | 15 | 08 | ¾ |
| 6 | 7 | 8 | 9 | 19 | 06 | ½ |
| 2 | 8 | 4 | 7 | 18 | 11 | ¾ |
| 6 | 9 | 8 | 5 | 17 | 11 | ½ |
| 3 | 2 | 1 | 4 | 16 | 11 | ¼ |
| 9 | 9 | 8 | 9 | 13 | 10 | ½ |
| 7 | 2 | 9 | 8 | 11 | 09 | ¼ |
| 2 | 6 | 5 | 7 | 18 | 08 | ½ |
| 5 | 4 | 3 | 2 | 19 | 07 | ¼ |
| 6 8 | 2 | 5 | 2 | 01 | 09 | ¼ |
| 6 0 | 6 | 5 | 5 | 02 | 10 | ¾ |
| 6 8 | 2 | 5 | 2 | 01 | 09 | ¼ |

Here

Here you may obſerve there are ſmall Figures put over the Figures of the *Total*, the Deſign of which is to help the Memory in the Carriage; as for Inſtance, when I work one of theſe Sums by the Method of adding up the whole Line, either from the *Bottom* to the *Top*, or from the *Top* to the *Bottom*, after I have found the *Amount* of the whole Line, I ſet down the odd *Money*, and over it, how many of the next Line or *Denomination*, are contained in this I am now about, as in the foregoing *Example*. Having caſt up the *Farthings*, I find it comes to 25, which is *Sixpence* and one *Farthing*; therefore I ſet down $\frac{1}{4}$ under the Line of *Farthings*, and 6 over it, as a Memorandum what *Pence* I carry to the Line of *Pence*, that I may ſee whether I agree, or am the ſame when I caſt that Line up the ſecond Time, by way of Proof; for tho' you begin at the *top* Figure, and ſo come gradually down to the *Bottom* one, 'tis call'd as much caſting up, or finding the Amount or *Total* of the *Line*, as if you began at the *Bottom*, and ſo went gradually up to the *Top*: The ſame is to be obſerv'd in the *Pence*, *Shillings* and *Pounds*; for coming with the 6 from the *Farthings*, I find the *Amount* or *Total* of the *Pence* is 117; by the *Table* I find 110 *Pence* is 9 *Shillings* and 2 *Pence*, conſequently 117 *Pence* is 9 *Shillings* and 9 *Pence*; for which, ſetting down the 9 odd *Pence*, I carry the 9 *Shillings* to the *Shillings*; and to prevent forgetting my Carriage, I write a ſmall $^{9}$ over the 9 ſet down; then going to the *Shillings*, I find them, with the 9 I carried, come to 1 ſingle *Shilling*; and 20 Times 10 or 200, which are 10 *Pounds*, which I likewiſe ſet down, and carrying this 10 to the *Units* Place of the *Pounds*, find it come to 82; therefore I ſet down the 2 and carry the 8 to the next *Row*, which comes to 75; here I ſet down the 5 and carry the 7 to the third *Row*, which comes to 72; here I ſet down the 2, and carry the 7 to the fourth *Row*, and that amounts to 68; and becauſe there are no more *Rows* to add, I ſet down 68, and the whole *Sum* is *L.* 68252 : 01 : 09 $\frac{1}{4}$; which you may prove by beginning at the Top, and ſo come down Figure by Figure to the Bottom, and you'll find the *Total* to be the ſame: Or you may part off the *top Line*, and add the other 11 Lines together, whoſe *Sum* or *Total* is *L.*60655 : 02 : 10 $\frac{3}{4}$, which added to the top Line that was cut or parted off, makes *L.*68252 : 01 : 09 $\frac{1}{4}$ the ſame with the whole *Amount* before found; but if you uſe *Dots* or *s, you need not make the 6 over the *Farthings*,

*things*, the 9 over the *Pence*, the 10 over the *Shillings*, &c. becauſe the Dots being counted come to the ſame Numbers.

*Example* 2, *which is only the* First *tranſpoſed.*

| *l.* | *s.* | *d.* | *q.* | | | | |
|---|---|---|---|---|---|---|---|
| 1234 | 15 | 08 | ¾ | | | | |
| 6789 | 19 | 06 | ½ | } | 17858 | 12 | 2 ½ |
| 2847 | 18 | 11 | ¾ | | | | |
| 6985 | 17 | 11 | ½ | | | | |
| 3214 | 16 | 11 | ¼ | | | | |
| 9989 | 13 | 10 | ½ | } | 23161 | 01 | 4 |
| 7298 | 11 | 09 | ¾ | | | | |
| 2657 | 18 | 08 | ½ | | | | |
| 5432 | 19 | 07 | ¼ | | | | |
| 7596 | 18 | 10 | ½ | } | 27232 | 08 | 2 ¾ |
| 8273 | 12 | 11 | ¾ | | | | |
| 5928 | 16 | 09 | ¼ | | | | |
| 68252 | 01 | 09 | ¼ | | 68252 | 01 | 9 ¼ |

*Note*, Where the Mark . is us'd, you are to underſtand the Work begun at the Bottom and went upwards; and where the Mark * is us'd, the Work is begun at the Top and comes down; though you may uſe either Mark for either Method, as beſt pleaſes you; but the Method uſed by the beſt Artiſts, is to add up the whole Line, if it be not too long, and if it be long, to divide it into two, three or more Parts, as you ſee done above.

*Example* 3, *which is a ſecond Variation of the* firſt Example.

| *l.* | | | | *s.* | *d.* | *q.* |
|---|---|---|---|---|---|---|
| 9. * | 9. * | 8. * | 9. * | 13. * | 10. * | ½. |
| 7 * | 2 | 9. * | 8. * | 11. | 09 * | ¾ * |
| 2 | 6. * | 5 * | 7. * | 18. * | 08. | ½. |
| 5. * | 4 | 3 | 2 | 19 * | 07. * | ¼ * |
| 7. | 5. * | 9. * | 6 * | 18. * | 10 * | ½. |
| 8 * | 2 | 7. | 3. | 12. * | 11. * | ¾ * |
| 5. * | 9. * | 2 * | 8. * | 16. | 09. | ¼. |
| 1 | 2 | 3. | 4 | 15. * | 08. * | ¾ * |
| 6. | 7. * | 8 * | 9. * | 19 * | 06 * | ½. |
| 2 | 8. * | 4. | 7. * | 18. * | 11. | ¾. * |
| 6 * | 9. * | 8. * | 5 | 17. * | 11. * | ½ * |
| 3. | 2 | 1 | 4. * | 16. * | 11. * | ¼ |
| 6 8 | 7 2 | 7 5 | 8 2 | 10 01 | 9 09 | 6 ¼ |
| 5 8 | 6 2 | 6 6 | 7 2 | 9 07 | 8 10 | 6 ¾ |
| 6 8 | 2 | 5 | 2 | 01 | 09 | ¼ |

This *Example* is the ſame Figures with the firſt, but only the Lines do not ſtand in the ſame Order, and is wrought in all the different Ways like the firſt; by which you ſee the *Total* or whole *Amount* is exactly the ſame, purſue what Method you pleaſe.

Here follows another *Example*, prov'd another Way.

| *l.* | *s.* | *d.* | *q.* | | | | |
|---|---|---|---|---|---|---|---|
| 3792 | 12 | 09 | ½ | | | | |
| 6285 | 13 | 11 | ¼ | | | | |
| 1233 | 14 | 10 | ¾ | | | | |
| 4564 | 15 | 07 | - | | | | |
| 7895 | 16 | 08 | - | 40366 | 01 | 7 | - |
| 126 | 17 | 06 | - | | | | |
| 37 | 18 | 05 | ½ | | | | |
| 6548 | 19 | 09 | ¼ | | | | |
| 9879 | 11 | 11 | ¾ | | | | |
| 350 | 15 | 10 | - | | | | |
| 929 | 10 | 11 | - | | | | |
| 848 | 16 | 08 | - | | | | |
| 617 | 09 | 07 | ½ | | | | |
| 86 | 18 | 06 | ¾ | 21494 | -- | 3 | ½ |
| 5 | 08 | 04 | ½ | | | | |
| 6 | 17 | 07 | ¾ | | | | |
| 8719 | 07 | 09 | - | | | | |
| 9928 | 14 | 11 | | | | | |
| 61860 | 01 | 10 | ½ | 61860 | 01 | 10 | ½ |
| 53047 | 9 | 5 | 2 | | | | |
| .8702 | 12 | 5 | | | | | |
| ..11. | ... | .. | | | | | |

61860 : 01 : 10 ½ Total.

Here you ſee this Example, conſiſting of eighteen *Lines*, divided into two *Parts*, and each *Part* added as if it were a ſeparate *Sum*; then thoſe two *Totals* are added together, and their *Total* comes to the ſame with the *Total* of the whole eighteen *Lines*, caſt up all in one Line; from whence may be concluded that 61860 *Pounds*, 1 *Shilling*, 10 *Pence* and 1 *Half-penny*, or 2 *Farthings*, is the true *Total* of the whole 18 *Lines*. You will obſerve that I have put over the particular Totals, the Carriage-Figures, both in the whole *Sum*, and in the 2 *Parts*, for the Eaſe of the Memory. Under-



neath

neath I have begun at the laſt *Row*, or *Row* of *Thouſands*, and having added it up, I find it come to 53; the 3 I ſet under the *Thouſands*, and the 5 a Degree backwarder to the *Left-hand*; then I add up the next, or third *Line*, and find that comes to 80; I ſet the 0 under the *Hundreds*, and the 8 under the *Thouſands*; then I add up the next *Row*, and find that comes to 74; the 4 I ſet under the *Tens*, and the 7 under the *Hundreds*; then I add up the *Units*, and find that *Row* comes to 107; I ſet down the 7 under the *Units* Place, the 0 under the *Tens* Place, and the 1 under the *Hundreds* Place; then I add up the *Shillings*, and find they come to 12 *Pounds*, 9 *Shillings*; the 9 I ſet down under the *Shillings*, the 2 *Pounds* I ſet under the *Units* Place of the *Pounds*, and the 1 under the *Tens* Place of the *Pounds*; then I add up the *Pence*, and find them come to 12 *Shillings* and 5 *Pence*; I ſet the 5 under the *Pence*, and the 12 under the *Shillings*, and then add up the *Farthings*, which come to 5 *Pence Half-penny*; I ſet down the 2 *Farthings* or *Half-penny*, under the *Farthings*, and the 5 *Pence* under the *Pence*. Now having gone through the ſeveral Lines of the *Sum*, I add the Particulars together, and find the *Total* to be the ſame as before, according to the *Axiom*, viz. *That the Whole is equal to all its Parts taken together*, let the Mode or Diſpoſition of them be how or what you will. I think I have now ſufficiently explain'd this Part; I ſhall only add, that if you change the Order of the *Lines* of this laſt *Example*, and work it over all the ſeveral Ways you have been before taught, 'twill make you ſo expert, that you will need no other Inſtruction for the Performance of any Thing of this Sort of Work; only I would adviſe you always to break any Sum that conſiſts of many Lines, into 2, 3, 4, or more Parts, as well as caſt them up in the Whole, which will make you much leſs liable to Miſtakes.

I will now ſhew you how you may uſe what you have learned in Buſineſs: As, *Suppoſe I have bought twelve Yards of* Cambrick, *at* 6*s.* 8*d. a Yard, What is the Amount, Value, or Price of the Whole?*

Here I may ſet down the Price of one *Yard* three Times, *thus:*

| | *s.* | *d.* |
|---|---|---|
| | 6 | 8 |
| | 6 | 8 |
| | 6 | 8 |
| 3 Yards is *L.* 1 | - | - |
| 3 more is *L.* 1 | - | - |
| 3 more is *L.* 1 | - | - |
| 3 more is *L.* 1 | - | - |
| 12 Yards is *L.* 4 | - | - |

Add theſe together, as before taught, and they will come to twenty *Shillings*, or one *Pound*, for the Price, Coſt, or Value of 3 *Yards*; which being ſet down four Times and added together will come to 4 *Pounds*, which is the Price of four Times 3, or 12 *Yards*.

Or you may ſet down the Price of 1 *Yard* 4 Times:

| | | *s.* | *d.* |
|---|---|---|---|
| Thus, the Price of | 1 Yard is - | 6 | 8 |
| | 1 more is - | 6 | 8 |
| | 1 more is - | 6 | 8 |
| | 1 more is - | 6 | 8 |
| Total Coſt of - - | 4 Yards is *L.* 1 | 6 | 8 |
| | 4 more is *L.* 1 | 6 | 8 |
| | 4 more is *L.* 1 | 6 | 8 |
| So that the total Coſt of - - | 12 *Yards* is *L.* 4 | - | - |

Or you may ſet down 1 *Yard* 6 Times:

| | *s.* | *d.* |
|---|---|---|
| Thus, 1 Yard coſt - | 6 | 8 |
| 1 ditto - - | 6 | 8 |
| 1 ditto - - | 6 | 8 |
| 1 ditto - - | 6 | 8 |
| 1 ditto - - | 6 | 8 |
| 1 ditto - - | 6 | 8 |
| The Coſt of 6 *Yards* is *L.* 2 | 0 | 0 |
| 6 more is *L.* 2 | 0 | 0 more |
| 12 *Yards* is *L.* 4 | 0 | 0 |

But

But the beſt and eaſieſt Method is as follows, *viz.* To ſet down the Price of one Yard, and multiply it by 12 at *once*, or by two or more Numbers, that, multiply'd continually together, will produce 12, the whole Number of Yards bought: As 6 Times 2, or 2 Times 6 is 12; or you may ſay 2 Times 2 is 4, and 3 Times 4 is 12, *&c.* Or 3 Times 4, or 4 Times 3, is 12; as you may ſee by the following *Examples*.

| | *s.* | *d.* | |
|---|---|---|---|
| Firſt ſet down | 6 : | 8 | the *Price* of one Yard |
| and *multiply* by | | 6 | |

and *L.* 2 : 0 : 0 will be the Price of 6 Yards.

Then *multiply* by 2

and *L.* 4 : 0 : 0 will be the *Coſt* or *Price* of twice 6 or 12 Yards.

| | *s.* | *d.* | |
|---|---|---|---|
| | 6 : | 8 | the Price of one *Yard* |
| *Multiply* by - | | 2 | |
| | 13 : | 4 | is the Coſt of two *Yards* |
| *Multiply* by | | 6 | |

*L.* 4 : 0 : 0 is the Value of twelve *Yards*.

Thus you may find the *Amount*, *Coſt*, or *Value* of any Number of *Yards*, *Pounds*, *Pieces*, *Hogſheads*, &c. the *Charge*, *Coſt* or *Price* of one being known. But to make the foregoing *Example* quite plain and eaſy to be underſtood, obſerve the following *Explanation*; firſt, the Price of one *Yard* being ſet down, which in this *Example* is 6 *s.* 8 *d.* I conſider what two Numbers multiply'd together, will produce 12, the whole Number of Yards bought, and I find 6 and 2, or 2 and 6, 3 and 4, or 4 and 3, will do it; then ſetting down 6 under the Price of one Yard, I begin, and ſay,

*Firſt Method.*

| *s.* | *d.* | |
|---|---|---|
| Thus 6 : | 8 | 6 Times 8 is 48, which being 48 *Pence*, by the *Pence-Table*, I find 48 *Pence* is juſt 4 *Shillings*, therefore ſet down 0 under the *Pence*, or make a - which you pleaſe, and carry the 4 *Shillings* to the next *Row* or *Column* of *Shillings*, ſaying, 6 Times 6 is 36, and 4 I carry is 40, which being 40 *Shillings* is juſt 2 *Pounds*; therefore ſet down 0 under the *Shillings*, or make a - as before in the *Pence*, |
| 6 | | |
| 2 : - : - | | |
| 2 | | |
| 4 : - : - | | |

*Second Method.*

6 : 8
2
13 : 4
6
4 : 00 : 00

*Third Method.*

6 : 8
3
1 : 00 : 00
4
4 : 00 : 00

*Fourth Method.*

6 : 8
4
1 : 6 : 8
3
4 : - : -

*Pence*, and then one *Column* further I ſet down the 2 *Pounds*; and this is the *Coſt*, *Price* or *Amount* of 6 *Yards*; then I ſet down 2, and *multiply* thereby, and the Product is 4 *Pounds*; for as there are no odd *Pence*, nor *Shillings*, the multiplying 0 by 2, or any other Number, will always produce 0; and when I come to the Column of *Pounds*, I ſay 2 Times 2 is 4, which are 4 *Pounds*, for the Value or Coſt of the 12 *Yards*. Or you may multiply by 2, and that Amount by 6, as you ſee in the ſecond *Method*, where I begin and ſay, 2 Times 8 is 16, which being *Pence*, is 1 *Shilling* and 4 *Pence*, I ſet down 4 *Pence* under the *Column* of *Pence*, and carry the 1 *Shilling*, ſaying, 2 Times 6 is 12, and 1 is 13; which being *Shillings*, and leſs than a *Pound*, I ſet them down under the *Column* of *Shillings*, and the *Product* or *Coſt* of 2 *Yards* is 13 *Shillings* and 4 *Pence*. Now 6 Times 2 being 12, I *multiply* this *Product* 13 *Shillings* and 4 *Pence* by 6, ſaying, 6 Times 4 is 24, which being *Pence*, is juſt 2 *Shillings*; therefore I ſet down 00's under the *Pence*, and carry the 2 *Shillings* forward, ſaying, 6 Times 3 is 18 and 2 carry'd is 20, for which I ſet down 0, and carry the 2, ſaying, 6 Times 1 is 6, and 2 is 8, which being 8 Times 10 *Shillings*, I halve it, and find the Half is 4; therefore I ſet down another 0, and the 4 being 4 *Pounds*, I ſet it down one Column further, towards the Left-hand, becauſe there are no more Figures to multiply; and ſo I find the *Product*, *Amount*, or *whole Charge* of the 12 *Yards* is 4 *Pounds*, as before. In the third Method I begin with 3, and ſay 3 Times 8 *Pence* is 24 *Pence*, which being juſt 2 *Shillings*, I ſet down 00, and carry the 2 *Shillings* forward, ſaying, 3 Times 6 *Shillings* is 18 *Shillings*, and 2 carry'd is 20 *Shillings* or 1 *Pound*; and there being no more Figures to multiply, I ſet down 00 under the *Shillings*, and 1 for the *Pound* in a Column by itſelf, a little further to the *Left-hand*; then conſidering that 4 Times 3 is 12, I multiply this Line or 1 *Pound*, which is the Product of 1 *Yard multiply'd* by 3, or the Coſt of 3 Yards, ſaying, 4 Times 00 *Pence* is 00, and 4 Times 00 *Shillings* is 00, and

4 Times

4 Times 1 *Pound* is 4; ſo I find the *Coſt* of 12 *Yards* is 4 *Pounds*, as before. In the fourth Method I multiply the Price of 1 Yard by 4, and that Product is the Value of 4 Yards, ſaying, 4 Times 8 is 32 *Pence*, which is 2 *Shillings* and 8 *Pence*; I ſet down 8 *Pence* under the *Pence*, and carry the 2 *Shillings* forward, ſaying, 4 Times 6 is 24, and 2 carry'd is 26 *Shillings*; which being 1 *Pound*, 6 *Shillings*, I ſet down 6 under the *Shillings*, and the 1 *Pound* a little further to the *Left-hand*; ſo the *Coſt* or *Amount* of 4 *Yards* will be found to be 1 *Pound*, 6 *Shillings* and 8 *Pence*; and 3 Times 4 being 12, I multiply this Line *L.* 1 : 6 : 8, by 3, ſaying, 3 Times 8 *Pence* is 24 *Pence*, which being juſt 2 *Shillings*, I make a Daſh - under the *Pence*, and carry the 2 *Shillings* forward, ſaying, 3 Times 6 *Shillings* is 18, and 2 carried is 20 *Shillings*, which being juſt 1 *Pound* make a Daſh - under the *Shillings*, and carry the 1 *Pound* forward; then ſay, 3 Times 1 *Pound* is 3 *Pounds*, and 1 *Pound* carry'd is 4 *Pounds*, which is the Amount of the 12 *Yards*, as before. Or you might have multiply'd by 12 at once, ſaying, 12 Times 8 *Pence* is 96 *Pence* or 8 *Shillings* exactly; ſet down 00, and carry the 8 *Shillings*, then going on and ſaying 12 Times 6 is 72, and 8 carry'd is 80, ſet down 0, and halve the 8, which is 8 Times 10 *Shillings*, and it makes juſt 4 *Pounds*, as before.

If the Price or Quantity was any other Value or Number, you may perform it after the ſame Manner; as, *If I buy* 42 POUNDS *of* TOBACCO *at* 13*d.* ½ *per Pound, What is the Value of the Whole?* Here I conſider that 6 Times 7, or 7 Times 6 make 42; ſo that I may multiply the given Price by either of theſe *Numbers* firſt, and then that *Product* by the other, and the laſt *Product* will be the Amount of the whole Quantity *bought* or *ſold*; and here, and always, when the Number of *Pence* exceeds a *Shilling*, ſet them down in *Shillings* and *Pence*, as follows, *viz.* 13*d.* ½ is one *Shilling*, one *Penny*, and one *Half-penny*, or 2 *Farthings*, which I ſet down thus:

| *s.* | *d.* | *q.* | |
|---|---|---|---|
| 1 : | 1 : | 2 | and firſt I *multiply* by 6 |
| | | 6 | |
| and 6 : | 9 : | - | is the Value or Coſt of 6 |
| Then I *multiply* by - | - | - 7 | *Pounds.* |
| and the *Product L.* 2 : | 7 : | 3 - - | is the Price of 6 Times 7, or 42 *Pounds.* |

*The*

*The ſecond Method.*

*s. d. q.*

1 : 1 ½ the Price of 1 *Pound*,

which I *multiply* by - - - 7

and 7 : 10½ is the Price of 7 *Pounds*;

then I *multiply* by 6

and the *Product L.* 2 : 7 : 3 is the Price of 6 Times 7, or 42 *Pounds.*

By both theſe *Methods* or *Ways* of doing the *Queſtion*, the *Total Amount*, is 2 *Pounds*, 7 *Shillings* and 3 *Pence*; for having ſet down the *Price* of 1 *Pound*, *viz.* 1 *s.* 1 *d.* 2 *q.* or 1 *Shilling* 1 *Penny* and 2 *Farthings*, I ſay 6 Times 2 *Farthings* is 12 *Farthings*, which is 3 *Pence*, therefore I make a Daſh - under the *Farthings* and carry the 3 *Pence* forward, ſaying, 6 Times 1 *Penny* is 6 *Pence*, and 3 carry'd is 9 *Pence*, which being leſs than a *Shilling*, I ſet it down under the *Pence*, and carry nothing; then I ſay, 6 Times 1 *Shilling* is 6 *Shillings*, which being leſs than a Pound, I ſet it down, and that Product is 6 *Shillings* and 9 *Pence*, which is the Coſt of 6 *Pounds* of *Tobacco* at this *Price* per *Pound:* Then as 7 Times 6 is 42, I *multiply* this Line by 7, ſaying, 7 Times 9 *Pence* is 63 *Pence*, which being 5 *Shillings* and 3 *Pence*, I ſet down the 3 *Pence* under the *Pence*, and carry forward the 5 *Shillings*; then I ſay, 7 Times 6 *Shillings* is 42 *Shillings*, and 5 carried, is 47 *Shillings.* Now there being no more Figures to be multiply'd, I ſet down the odd 7, and halve the 4, the Half of which being 2, is 2 *Pounds*; ſo that the Coſt of 42 *Pounds* of *Tobacco*, at this Price, is 2 *Pounds*, 7 *Shillings* and 3 *Pence.* And for a Proof of the Truth of the Work, you ought always to do it at leaſt two different Ways: Therefore you ſee it is ſet down thus, 1 *s.* 1 *d.* ½ in the *ſecond Method*, and *multiply'd* by 7, by ſaying, 7 *Half-pence* is 3 *Pence Half-penny*; I ſet down ½ and carry 3 to the *Pence*; then ſay, 7 Times 1 *Penny* is 7 *Pence*, and 3 carried is 10 *Pence*, which being leſs than a *Shilling*, is ſet down, and nothing carried; then 7 Times 1 *Shilling* is 7 *Shillings*, which is alſo ſet down, and the Amount of 7 *Pounds* of this *Tobacco* is now found to be 7 *Shillings* and 10 *Pence Half-penny*; and as 6 Times 7 being 42, I multiply this Line by 6, ſaying, 6 *Half-pence* is juſt 3 *Pence*; therefore I make a Daſh - under the *Farthings*, and carry the 3 *Pence* forward,

forward, ſaying, 6 Times 10 *Pence* is 60 *Pence*, and 3 carried is 63 *Pence*, which being 5 *Shillings* and 3 *Pence*, I ſet down 3 *Pence* and carry the 5 *Shillings*; then I ſay, 6 Times 7 *Shillings* is 42, and 5 carried is 47 *Shillings*: Here ſet down the 7 under the *Shillings*, and halve the 4, which are 4 Times 10 *Shillings*, and the Half being 2, I ſet it down a little further, and the whole Amount is 2 *Pounds*, 7 *Shillings* and 3 *Pence*, as before; from whence you may conclude both the Operations are right. After the ſame Manner you may find the Value of any other Quantities, at any other Rates: As; *Suppoſe a* Butcher *buys* 24 Calves, *at* 3 Pounds, 5 Shillings *and* 6 Pence *a Piece*, *What do they all come to?* Here firſt, I ſet down the Price of one, and conſider that 4 Times 6, or 6 Times 4 is 24; or 3 Times 8, or 8 Times 3 is 24; or that 2 Times 12, or 12 Times 2 is 24. Now I may take any of theſe 2 Numbers; and if the Work is rightly performed, the laſt *Product* or *Total* Charge will always be the ſame; as you may ſee by the ſeveral Operations following.

| *l.* | *s.* | *d.* | *l.* | *s.* | *d.* | *l.* | *s.* | *d.* | *l.* | *s.* | *d.* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 5 | 6 | 3 | 5 | 6 | 3 | 5 | 6 | 3 | 5 | 6 |
| | | 4 | | | 6 | | | 3 | | | 8 |
| 13 | 2 | - | 19 | 13 | - | 9 | 16 | 6 | 26 | 4 | - |
| | | 6 | | | 4 | | | 8 | | | 3 |
| 78 | 12 | - | 78 | 12 | - | 78 | 12 | - | 78 | 12 | - |

| *l.* | *s.* | *d.* | *l.* | *s.* | *d.* |
|---|---|---|---|---|---|
| 3 | 5 | 6 | 3 | 5 | 6 |
| | | 2 | | | 12 |
| 6 | 11 | - | 39 | 6 | - |
| | | 12 | | | 2 |
| 78 | 12 | - | 78 | 12 | - |

Here you ſee this *Queſtion* ſolv'd ſix different Ways, and tho' the firſt *Product* in each varies greatly, yet the laſt *Product* is the ſame in all of them, by which you may be aſſured they are all right. I have ſo fully explain'd the two foregoing Queſtions, that this cannot want any: I ſhall only take Notice, that the firſt nine Rows of Figures, in the ſecond Part of the *Pence-Table*, Page 30, will teach you to multiply by 12, at once, all manner of *Sums*, that can require ſuch an Operation; for 'tis the ſame Thing to ſay, 12 Times 1 is 12, as to ſay, 12 *Pence* is 1 *Shilling*; and 12 Times 2, is 24, as to ſay, 2 *Shillings* are 24 *Pence*, &c. Now this *Queſtion* may be done by *Addi-*

*tion*, if you ſet down the Price of 1, two, 3, 4, &c. Times, and double that *Product*, &c. till you make up the Number 24, as you may obſerve by what is here under done.

| | *l.* | *s.* | *d.* | |
|---|---|---|---|---|
| | 3 : | 5 : | 6 | the Coſt of 1 *Calf.* |
| | 3 : | 5 : | 6 | - - - - 1 more. |
| The *Total* | 6 : | 11 : | - | is the Coſt of 2 *Calves.* |
| | 6 : | 11 : | - | - - - of 2 more. |
| The *Total* | 13 : | 2 : | - | is the Coſt of 4 *Calves.* |
| | 13 : | 2 : | - | - - of 4 more. |
| The *Total* | 26 : | 4 : | - | is the Coſt of 8 *Calves.* |
| | 26 : | 4 : | - | - - - - - 8 more. |
| | 26 : | 4 : | - | - - - - 8 more. |
| The *Total* | 78 : | 12 : | - | is the Coſt of 24 *Calves.* |

| | *l.* | *s.* | *d.* | |
|---|---|---|---|---|
| | 3 : | 5 : | 6 | the Price of 1 *Calf.* |
| | 3 : | 5 : | 6 | - - - - 1 more. |
| | 3 : | 5 : | 6 | - - - - 1 more. |
| The *Total* | 9 : | 16 : | 6 | is the Price of 3 *Calves.* |
| | 9 : | 16 : | 6 | - - - - 3 more. |
| The *Total* | 19 : | 13 : | - | is the Price of 6 *Calves.* |
| | 19 : | 13 : | - | - - - - 6 more. |
| The *Total* | 39 : | 06 : | - | is the Price of 12 *Calves.* |
| | 39 : | 06 : | - | - - - 12 more. |
| The *Total* | 78 : | 12 : | - | is the Price of 24 *Calves.* |

Thus you ſee, *Addition* and *Multiplication* always produce the ſame *Total Amounts*, let the Particulars be what they will. I ſhall now go on to ſhew you how to act in ſuch Caſes, where the given *Number*, or whole *Quantity* bought or ſold, cannot be exactly found in, or by the *Table*, viz. ſuch as theſe that follow. *What comes* 23 Ells *of* Dowlaſs *to, at* 16 *d.* ½ *per* Ell? Here I conſider, and find the *Table* has no *Numbers*, but what are either too much or too little; and becauſe

becauſe I have not yet taught you *Subſtraction*, you muſt not take any *Numbers* too large; and therefore you muſt take two or more *Numbers* that are too little; ſuch as 3 Times 7, or 7 Times 3, or 4 Times 5, or 5 Times 4, or 3 Times 6, or 6 Times 3, *&c.* and under this Circumſtance 'tis always beſt to take 2 *Numbers*, whoſe *Product* comes the neareſt to the given *Number*; as in this *Example*, 3 Times 7, or 7 Times 3, which is 21, is the neareſt leaſt *Number*, or *Product* in the *Table*, to 23, the given *Number* or *Quantity*, whoſe *Value* or *Amount* is required; and therefore I work with the 3 and 7, or 7 and 3, as before directed, thus:

| | *s.* | *d.* | *q.* | |
|---|---|---|---|---|
| | 1 : | 04 | ½ | the Price or Coſt of 1 *Ell*. |
| Multiply'd by | | 3 | | |
| Gives | 4 : | 01 | ½ | the Price or Coſt of 3 *Ells*. |
| Then multiply by | | 7 | | |
| *L.* 1 : | 08 : | 10 | ½ | is the Price or Coſt of 7 Times 3, or 21 *Ells*. |
| To which add 01 : | 04 | ½ | | the Price of 1 *Ell* more. |
| and 01 : | 04 | ½ | | - - - 1 *Ell* more. |
| The *Total* *L.* 1 : | 11 : | 07 | ½ | is the *Price* of 23 *Ells*. |

| | *s.* | *d.* | *q.* | |
|---|---|---|---|---|
| Or thus | 1 : | 04 | ½ | the Price of 1 *Ell*. |
| Multiply'd by | | 7 | | |
| Gives | 09 : | 07 | ½ | the Price of 7 *Ells*. |
| This multiply'd by | | 3 | | |
| Gives *L.* 1 : | 08 : | 10 | ½ | the *Price* of 21 *Ells*. |
| Multiply 1 *Ell* by 2 and it comes to | 02 : | 09 | - | the *Price* of 2 *Ells*, which being added to |

21 *Ells* gives *L.* 1 : 11 : 07 ½ for the *Price* of 23 *Ells*, as before.

Here you are to obſerve, that as 3 Times 7 makes but 21, there was 2 wanting to make it 23; therefore I ſet down the Price of one *Ell* twice, and then adding the Whole together, find it comes to 1 *Pound*, 11 *Shillings* and 7 *Pence Half-penny*. Now to be ſatisfied that the Work is right, I begin with the 7, and then *multiply* that *Product* by 3; and as 2 are ſtill wanting, I *multiply* the Price of

1 by 2, and add that *Product* to the laſt *Product*, and the *Total* of thoſe two *Products* gives the *Amount* of the 23 *Ells* ſought after, and which is the ſame with what was found before. Now if you take any other two *Numbers*, and add to the laſt *Product* the Price of ſo many ſingle *Ells.* as are wanting, to make up the *Number* required, you will find the *Total* always to come out the ſame, if your Work is right; as for Inſtance,

| | *s.* | *d.* | *q.* | |
|---|---|---|---|---|
| | 1 : | 4 | ½ | the Price of 1 *Ell.* |
| *Multiply'd* by | | 4 | | |
| Gives | 5 : | 6 | - | for the Price of 4 *Ells.* |
| This *multiply'd* by | | 5 | | |
| Gives | 1 : | 7 : | 6 - | for the *Price* of 20 *Ells.* |
| 1 Ell *multiply'd* by 3 gives | 4 : | 1 | ½ | the *Price* of 3 *Ells.* |
| *Total* L. 1. : | 11 : | 7 | ½ | is the *Price* of 23 *Ells.* |

| | *s.* | *d.* | *q.* | |
|---|---|---|---|---|
| Or *multiply* | 1 : | 4 | ½ | the Price of 1 *Ell.* |
| by | | 2 | | |
| and | 2 : | 9 | - | will be the Price of 2 *Ells.* |
| This *multiply'd* by | | 9 | - | |
| gives *L.* 1 : | 4 : | 9 | - | for the Price of 18 *Ells,* |
| and 1 *Ell* by 5 gives | 6 : | 10 | ½ | for the Price of 5 *Ells.* |
| The *Total* is *L.* 1 : | 11 : | 7 | ½ | for the Price of 23 *Ells.* |

And ſo of any other two Numbers, whoſe Product is leſs than the given Number: As, ſuppoſe 4 Times 4, which is 16; then I muſt multiply the Price of 1 by 7, to add to 16, to make up the 23 required. Again, *What comes* 39 Sheep *to, at* 18 *s. and* 9 *d. a Piece?* Here 6 Times 6, or 4 Times 9 is 36; and this is the neareſt *Product* of any 2 *Numbers* in the *Table*, ſo that having us'd either of theſe, then you muſt add the Value or Price of 3 more to the laſt *Product*, and you have the true Anſwer, if your Work is rightly performed; as you ſee done in the following Page.

| *l.* | *s.* | *d.* | |
|---|---|---|---|
| - | 18 | 09 | the Price of 1 *Sheep.* |
| *Multiply'd* by | | 6 | |
| Gives 5 | 12 | 06 | for the *Price* of 6 *Sheep.* |
| This *multiply'd* by | | 6 | |
| Gives *L.* 33 | 15 | - | for the *Price* of 36 *Sheep.* |
| 1 by 3 gives 2 | 16 | 03 | for the *Price* of 3 *Sheep.* |
| *Total L.* 36 | 11 | 03 | is the Price of 39 *Sheep.* |

| *l.* | *s.* | *d.* | |
|---|---|---|---|
| - | 18 | 09 | the Price of 1 *Sheep.* |
| | | 4 | |
| 3 | 15 | - | the Price of 4 *Sheep.* |
| | | 9 | |
| *L.* 33 | 15 | - | the Price of 36 *Sheep.* |
| 2 | 16 | 03 | the Price of 3 *Sheep.* |
| *L.* 36 | 11 | 03 | the Price of 39 *Sheep.* |

If you make Choice of 4 Times 8, or 8 Times 4, whose *Product* is 32, then you must *multiply* the Price of 1 by 7, to make up the 39, *&c.*

Again, *What is the Value of* 58 Pieces *of fine* Holland, *if* 1 *Cost L.* 7 : 13 : 8 *?* Here you may take 7 Times 8, or 8 Times 7, which is 56, and to the last Product, add the Product of 1, multiply'd by 2, and the whole Amount will be *L.* 445 : 12 : 08; or you may take 6 Times 9, or 9 Times 6, whose *Product* is 54, and to the last *Product*, add the *Product* of the first Line, or Price of 1 *Piece*, multiply'd by 4, and you will find the *Total* of both Ways come alike, if your Work is right; as you may see done here under.

| *l.* | *s.* | *d.* | |
|---|---|---|---|
| 7 | 13 | 08 | the Value of 1 *Piece.* |
| | | 7 | |
| 53 | 15 | 08 | the Value of 7 *Pieces.* |
| | | 8 | |
| 430 | 05 | 04 | the Value of 56 *Pieces.* |
| 15 | 07 | 04 | the Value of 2 *Pieces.* |
| *L.* 445 | 12 | 08 | the Value of 58 *Pieces* |

| *l.* | *s.* | *d.* | |
|---|---|---|---|
| 7 | 13 | 08 | the Value of 1 *Piece.* |
| | | 6 | |
| 46 | 02 | - | the Value of 6 *Pieces.* |
| | | 9 | |
| 414 | 18 | - | the Value of 54 *Pieces.* |
| 30 | 14 | 08 | the Value of 4 *Pieces.* |
| *L.* 445 | 12 | 08 | the Value of 58 *Pieces.* |

So if the *Value*, *Coſt*, or *Price* of 67 *Any-things* were required when the *Value*, *Coſt* or *Price* of 1 was, *L.*58 : 17 : 10¼. Here you might take 8 Times 8, and add the *Value* or *Amount* of 3 *ſingle ones* to the laſt *Product*; you will find the *Total* come to *L.* 3945 : 19 : -¼; or if you take 7 Times 9, or 9 Times 7, and add the *Price* of 1 *multiply'd* by 4, to the laſt *Product*, you will find the *Total* to be the ſame. Now I preſume you have been ſufficiently inſtructed in whatever is neceſſary, for all *Numbers*, under 100: I will only add one or two Examples more, and then ſhall go on to ſhew you how to find the Value or Number ſought, when it exceeds 100, and then ſhall go on to the *Addition* of *Weights* and *Meaſures*. As, *Suppoſe I buy* 8 *Yards* of *Muſlin* at 3 *s.* 7*d.* per *Yard*, 9 *Ells* of *Holland*, at 5 *s.* 9*d.* per *Ell*, 18 *Yards* of *Silk*, at 11 *s.* 6*d.* per *Yard*, 24 *Yards* of *Lace*, at 17 *s.* 8*d.* per *Yard*, 10 *Yards* of *Cambrick*, at 9 *s.* 9*d.* per *Yard*; and 75 *Ells* of *Sheeting*, at 2 *s.* 4½ per *Ell*, *What do they all come to?* Here I ſet down the Particulars, and find their Values as has been already taught; then I ſet down the ſeveral *Amounts* or *Values* under one another, and the *Total* is the *Anſwer* to the *Queſtion*, as follows,

| | *s.* | *d.* | | *l.* | *s.* | *d.* |
|---|---|---|---|---|---|---|
| 8 *Yards* of *Muſlin* at | 3 | 7 | per *Yard* comes to | 1 | 08 | 08 |
| 9 *Ells* of *Holland* at | 5 | 9 | per *Ell*, comes to | 2 | 11 | 09 |
| 18 *Yards* of *Silk* at | 11 | 6 | per *Yard*, comes to | 10 | 07 | -- |
| 24 Ditto of *Lace* at | 17 | 8 | Ditto - - - | 21 | 04 | -- |
| 10 *Ditto* of *Cambrick* at | 9 | 9 | *Ditto* - - - | 4 | 17 | 06 |
| 75 *Ells* of *Sheeting* at | 2 | 4½ | per *Ell* - - | 8 | 18 | 01½ |
| | | | *Total* | 49 | 07 | --½ |



Now

Now for Numbers that are larger than 100: As, *What is the Value of* 320 Buſhels *of* Corn, *at* 4 *s.* 9*d.* ½ *per* Buſhel? Whenever the given Number conſiſts of 3 *Figures*, as in the *Example*, ſee if the 2 *Figures* towards the Left-hand are the Product of any two Figures in the *Table*; and if they are, multiply the Price of 1, by thoſe two Figures, as you have been already taught, and the laſt Product multiply by 10, and you have all but what ſtands in the *Units Place*, by which you muſt multiply the Price of 1, and add that Product to the Product of 10, and your Work is done; the *Total* being the Amount of the Quantity ſought after, if your Work is rightly performed; in the Example given, the two laſt Figures are 32, which is the Product of 4 and 8, or 8 and 4; therefore I ſet down the Price of 1 or 4: 9½ and work, as here under.

| | *s.* | *d.* | *q.* | |
|---|---|---|---|---|
| | 4 : | 9 | ½ | the Price of 1 *Buſhel.* |
| | | 4 | | |
| | 19 : | 2 | - | the Price of 4 *Buſhels.* |
| | | 8 | | |
| | 7 : | 13 : | 4 - | the Price of 8 Times 4, or 32 *Buſhels.* |
| | | 10 | | |
| *L.* | 76 : | 13 : | 4 - | the Price of 10 Times 32, or 320 *Buſhels.* |

| | *s.* | *d.* | | |
|---|---|---|---|---|
| Or thus, | 4 : | 9 | ½ | the Value of 1 *Buſhel.* |
| | | 8 | | |
| | 1 : | 18 : | 4 - | the Value of 8 *Buſhels.* |
| | | | 4 | |
| | 7 : | 13 : | 4 - | the Value of 4 Times 8, or |
| | | | 10 | 32 *Buſhels.* |
| *L.* | 76 : | 13 : | 4 - | the Value of 10 Times 32, or |
| | | | | 320 *Buſhels.* |

*So*

*So if the Price of an* Ox *was L.* 8 : 13 : 6, *What would* 189 Oxen *come to?* Here I take 3 Times 6, or 6 Times 3, or 2 Times 9, or 9 Times 2, for the 18; then *multiply* that *Product* by 10, and the laſt *Product* will be 180; then I *multiply* the *Price* of 1 by the 9 *Units*, and *add* that *Product* to the *Product* of 180, and the *Total Amount* is *L.* 1639 : 11 : 6 as you may ſee by the *Example.*

| | *l.* | *s.* | *d.* |
|---|---|---|---|
| 1 *Ox* Coſt | 8 | 13 | 06 |
| | | | 9 |
| 9 *Oxen* Coſt | 78 | 01 | 06 |
| | | | 2 |
| 18 *ditto* Coſt | 156 | 03 | - |
| | | | 10 |
| 180 *Oxen* Coſt *L.* | 1561 | 10 | - |
| 9 *Oxen* Coſt | 78 | 01 | 06 |
| 189 *Oxen* Coſt *L.* | 1639 | 11 | 06 |

Again, *What comes* 635 *Pounds* of *Tobacco* to at 11 *d.* $\frac{1}{4}$ per *Pound?* Here the 2 laſt *Figures* are 63, which is the *Product* of 7 and 9, or 9 and 7; when you have found the *Amount* of 63, *multiply* the laſt *Product* of theſe 2 *Figures* by 10, and this third *Product*, gives 630; and the firſt Line, or 11 *d.* $\frac{1}{4}$ the Price of 1 *Pound*, muſt be *multiply'd* by 5, and that *Product added* to the laſt *Product* or *Amount* of 630, yields *L.* 29 : 15 : 3 $\frac{3}{4}$ for the whole 635 *Pounds*; and ſo on for any other *Number* whatever, whoſe 2 laſt Figures are the *Product* of ſome two other ſingle *Figures*; as, 728 *Dollars*, at 4 *s.* 7 *d.* $\frac{1}{4}$ per *Dollar*, comes to *L.* 167 : 11 : 10; and 817 *French Crowns*, at 5 *s.* 2 *d.* $\frac{1}{4}$ per *Crown*, comes to *L.* 213 : 12 : 2 $\frac{1}{4}$. When the 2 laſt *Figures* are not the exact *Product* of ſome two other *ſingle Figures*, take the *Product*, that is the next leaſt, and work as above; only work with the 10 firſt, and you will have the *Total*, all but ſo many *Tens* as the *Product* of the 2 Figures you choſe, was ſhort of the two laſt Figures of the given *Number* to the *Left-hand*; for which *multiply* the firſt *Product*, or Reſult of the firſt Line, multiply'd by *Ten*, by ſo many *Units* as there are *Tens* wanting; and add this laſt *Product* to the laſt, or third Product found before, and their *Total* will be the *Amount* of the whole *Sum* required, if your Work has been rightly performed. See an *Example*; *What comes* 516 Portugal-Pieces *of* Gold *to*, *each* 36 Shillings *Sterling?* Anſwer, *L.* 928 : 16. Here I conſider that 5 Times 10 is 50; therefore

therefore I *multiply* *L.* 1 : 16 by 10, and then that *Product* by 5, and that *Product* by 10, and I have got the Value of 500; then as 16 are ſtill wanting, I ſet down the firſt Product *L.* 18 for 10 Pieces, and multiply *L.* 1 : 16 by 6, and add theſe three Lines together, and find the *Total* is *L.* 928 : 16.

| | | | |
|---|---|---|---|
| | 10 | | |
| 18 | : 00 | the Value of | 10 Pieces. |
| | 5 | | |
| 90 | : 00 | the Value of | 50 Pieces. |
| | 10 | | |
| 900 | : 00 | the Value of | 500 Pieces. |
| 18 | : 00 | the Value of | 10 Pieces. |
| 10 | : 16 | the Value of | 6 Pieces. |
| *L.* 928 | : 16 | the Value of | 516 Pieces. |

Now for the *Proof* of this *Operation*, firſt multiply by 10, and then take 6 Times 8, which will be 48; ſo that 3 are wanting to make up 51, for which *multiply* the firſt *Product* by 3, and ſet that *Product* down under the third or laſt *Product*; and then *multiply* the *Value* of 1 by the *Units*, and add theſe 3 *Sums* together, and their *Total* will be the ſame with that above, if your Work is rightly performed; as you will ſee by what follows.

| | | | | |
|---|---|---|---|---|
| *L.* | 1 | : 16 | the Value of | 1 Piece. |
| *Multiply* by | | 10 | | 10 |
| the *Product* | 18 | : 00 | is the Value of | 10 Pieces. |
| That *multiply'd* by | | 6 | | 6 |
| the *Product* | 108 | : 00 | is the Value of | 60 Pieces. |
| This *multiply'd* by | | 8 | | 8 |
| the *Product* | 864 | : 00 | is the Value of | 480 Pieces. |
| The firſt Product by 3 is | 54 | : 00 | the Value of | 30 Pieces. |
| The Value of 1 by 6 is | 10 | : 16 | the Value of | 6 Pieces. |
| *Total L.* | 928 | : 16 | is the Value of | 516 Pieces, |

as before.

So if you ſuppoſe that a *Seaman*'s Wages comes to *L.* 14 : 19 : 6 *per Annum*, *What will pay a* Man *of* War *of* 684 *ſuch Men?* Here 8 Times 8, which is 64, is the neareſt *Tabular-Product*, that is leſs than the *Sum* required; wherefore I *multiply* by 10 : 8, and 8; and the firſt *Product* by 4, for the 4 Tens wanting to make up the 68; and then

multiply the Charge of 1 *Man* by 4, for the 4 *Units*; add the ſeveral *Products* together, and the *Total* is the Anſwer required: Or you may take 7 and 9 for 63; and then the firſt *Product* muſt be *multiply'd* by 5, to make up the 63, 68, as you ſee done in the following *Examples*.

| | *l.* | *s.* | *d.* | | |
|---|---|---|---|---|---|
| | 14 | 19 | 6 | the Pay of | 1 *Man.* |
| *Multiply'd* by | | | 10 | | 10 |
| The *Product* | 149 | 15 | - | is the Pay of | 10 *Men.* |
| This *multiply'd* by | | | 8 | | 8 |
| The *Product* | 1198 | 00 | - | is the Pay of | 80 *Men.* |
| This *multiply'd* by | | | 8 | | 8 |
| The *Product* | 9584 | 00 | - | is the Pay of | 640 *Men.* |
| Firſt *Pro.* mult. by 4 is | 599 | 00 | - | the Pay of | 40 *Men.* |
| 1 Man by 4 is | 59 | 18 | - | the Pay of | 4 *Men.* |
| The *Total* | 10242 | 18 | - | is the Pay of | 684 *Men.* |

| | *l.* | *s.* | *d.* | | |
|---|---|---|---|---|---|
| Or thus, | 14 | 19 | 6 | for | 1 *Man.* |
| | | | 10 | | 10 |
| | 149 | 15 | - | for | 10 *Men.* |
| | | | 7 | | 7 |
| | 1048 | 05 | - | for | 70 *Men.* |
| | | | 9 | | 9 |
| | 9434 | 05 | - | for | 630 *Men.* |
| | 748 | 15 | - | for | 50 *Men.* |
| | 59 | 18 | - | for | 4 *Men.* |
| | 10242 | 18 | - | for | 684 *Men.* |

And thus you may find the *Value* of any 3 *Figures* whatever, which is ſufficient for all *common Buſineſſes*; and therefore I ſhall go on to the *Weights* and *Meaſures*. And firſt in

## CLOTH MEASURE.

You are to obſerve that 4 *Nails make* 1 *Quarter of a Yard*; 4 *Quarters*, 1 *Yard*; 5 *Quarters of a Yard is an* Engliſh

liſh *Ell*; 3 *Quarters of a Yard*, *a* Flemiſh *Ell*; *and* 6 *Quarters of a Yard a* French *Ell*, *or Aulm.*

## CLOTH-MEASURE.

| *Yards* | *Qrs.* | *Nails* |
|---|---|---|
| 367 | 1 | 3 |
| 582 | 2 | 1 |
| 796 | 3 | 3 |
| 842 | 2 | 2 |
| 371 | 1 | 1 |
| 976 | 0 | 3 |
| 789 | 2 | 2 |
| 555 | 0 | 3 |
| 666 | 1 | 2 |
| 848 | 3 | - |
| 921 | 1 | 3 |
| 316 | 2 | - |
| 827 | 3 | 2 |
| 77 | 6 | 6 |
| 8862 | 3 | 1 |

| *Ells* | (5) *Qrs.* | (4) *Nails* |
|---|---|---|
| 67 | 4 | 1 |
| 32 | 1 | 2 |
| 81 | 3 | 2 |
| 96 | 1 | - |
| 74 | 2 | - |
| 83 | 4 | 2 |
| 62 | 3 | 1 |
| 71 | 1 | 3 |
| 58 | - | - |
| 10 | - | - |
| 11 | 2 | 2 |
| 12 | 1 | 2 |
| 13 | 3 | 1 |
| 675 | 4 | - |

| *Ell* Flem. | (3) *Qrs.* | (4) *Nails* |
|---|---|---|
| 5827 | 1 | 3 |
| 165 | 1 | 3 |
| 382 | 2 | 3 |
| 71 | 2 | 1 |
| 58 | 1 | 3 |
| 6 | 2 | 3 |
| 6 | 1 | 2 |
| 19 | 2 | 2 |
| 18 | 1 | 3 |
| 752 | - | 1 |
| 643 | - | 1 |
| 9836 | - | 3 |
| 8271 | 2 | 2 |
| 26061 | 1 | 2 |

| *Aulm* | *Qrs.* | *Nails* |
|---|---|---|
| 58 | 5. * | 2 |
| 36 | 1 * | 2. * |
| 75 | 4 | 1 |
| 44 | 3. * | 1 |
| 56 | 2 | 3. * |
| 67 | 5. * | 3. * |
| 78 | 5. * | 1 |
| 89 | 4. | 2 |
| 91 | 3 * | 3. * |
| 10 | 3. * | 3. * |
| 86 | 2 * | 2 |
| 77 | 5. * | 3. * |
| 94 | 4. | 1 |
| 869 | 4 | 3 |

In theſe *Examples*, you may begin at the *Bottom* and go upwards, or at the *Top* and come downwards, as beſt pleaſes you; and when you have found what the *Sum* of the *Nails* is, then conſider how many *Quarters* are contained in them, that is, how many Times 4 is in that Number, the ſame

as you did in the *Farthings*: As here, in the firſt *Example* to the *Left-hand*, the *Nails* come to 25, which is 6 Times 4, and 1 over; therefore I ſet down the Overplus 1, and carry the 6 *Quarters* to the *Quarters*, and having added them up, find them come to 27, with the 6 carried. Now 27 *Quarters* is 6 *Yards*, and 3 *Quarters*, becauſe 6 Times 4, is 24, and 3 is 27; therefore I ſet down the 3 odd *Quarters*, and carry the 6 *Yards* to the *Yards*, and *add* them, the ſame as if they were *Pounds* of *Money*, *Sheep*, *Houſes*, &c. as in the *Examples* of whole *Numbers* and *Money*; and the whole *Sum* comes to 8862 *Yards*, 3 *Quarters* and 1 *Nail*, which you may prove by breaking it into two or more Parts, and finding the *Total* of each Part, and then adding thoſe *Totals* together, and you will find their *Total* come to the ſame as above: Or you may make a *Dot* . or * at every 4 *Nails* in the *Nails*, as you was ſhewn in the *Farthings*, and as you ſee done in the fourth *Example*, where you'll obſerve that the *Dots* or . 's go *upwards*, and the *'s come *downwards*. In the ſaid fourth *Example* the *Dots* are made at 6, in the *Quarters*, becauſe 6 *Quarters* is an *Aulm*, or *French* Ell; the like muſt be obſerv'd in the other *Examples*, viz. to dot at 4 in the *Quarters*, when the whole Numbers are *Yards*, as in the firſt *Example*; by 5, when they are *Engliſh* Ells, as in the ſecond *Example*; and by 3, when they are *Flemiſh* Ells, as in the third *Example*; and if you think 'twill be any Advantage to your Memory, you may ſet down what you *ſtop* or *count* by, over the Head of the Line or Column of the inferior Denominations, as in the ſecond and third *Examples* above, where over the *Nails* is ſet 4, becauſe all the Diviſions above, are proportion'd to the *Engliſh Yard*, and 4 *Nails* make a *Quarter* of a *Yard*; and in the ſecond *Example*, over the *Quarters*, ſtands 5, becauſe 5 *Quarters* of a *Yard* is an *Engliſh* Ell; and in the third *Example*, over the *Quarters*, ſtands 3, becauſe 3 *Quarters* of a *Yard* is a *Flemiſh* or *Dutch* Ell. I have ſet nothing over the *Engliſh* or *Flemiſh* Ells, becauſe all whole Numbers whatever, whether *Monies*, *Weights*, *Meaſures*, *Time*, &c. are always counted by *Tens*; as in the *Addition* of whole *Numbers*, has already been fully explain'd.

## LONG MEASURE.

This is only us'd in, or apply'd to know the Diſtance of one *Place* from another, and to ſettle the Rates of *Poſt-Horſes*,

*Horſes*, *Coaches*, *Letters*, &c. wherein a *Mile*, being the *Integer* or *whole Thing*, the uſual *Subdiviſions* are as follow; 3 *Barley Corns make* 1 *Inch*, 12 *Inches* 1 *Foot*, 3 *Feet* 1 *Yard*, 5½ *Yards*, *or* 11 *half Yards* 1 *Pole or Perch*, 40 *Poles or Perches* 1 *Furlong*, *and* 8 *Furlongs* 1 *Mile*.

## Long-Measure.

This is uſed to meaſure *Roads*, or the Diſtance of one *Place*, *Town*, or City from another.

| *Miles* | *Furlongs* (8) | *Poles* (40) | ½ *Yards* (11) | *Inches* (18) |
|---|---|---|---|---|
| 38 | 5. | 17. | 10. | 13 |
| 29 | 4. | 37. | 10. | 17. |
| 63 | 7 | 16 | 07 | 14. |
| 82 | 6. | 25. | 10. | 12. |
| 98 | 2 | 18 | 09. | 13. |
| 76 | 4. | 28. | 08. | 14 |
| 58 | 3 | 38. | 07. | 15. |
| 36 | 7. | 29. | 06 | 16. |
| 27 | 6. | 39 | 10 | 17. |
| 65 | 5. | 32. | 09. | 08 |
| 579 | 0 | 07 | 05 | 13 |

Here you will obſerve, that as 3 *Feet*, or 36 *Inches* make 1 *Yard*; ſo 18 *Inches*, or 1 *Foot* and ½ make ½ *Yard*; ſo I put over the *Column* of *Inches* 18, and I make Dots or *'s at every 18; and in the *Column* of ½ *Yards*, I do the ſame at every 11; and in the *Column* of *Poles*, I do the ſame at every 40; and in the *Furlongs*, at every 8; and in the *Miles* go by 10, as in *Addition* of *Whole Numbers*; for the laſt *Column*, let it be called what it will, is always eſteemed whole Numbers; and after the Whole is gone through, it amounts to 579 *Miles*, 7 *Poles*, 5 *half Yards*, and 13 *Inches*: You may vary the Order of the *Figures* of this *Example*, and then 'twill be another *Example*, of which you will find the *Total* always come to the ſame, if the Work be rightly performed.

## LAND or SQUARE MEASURE.

This is peculiarly adapted to *Surveying*, it being the Contents of the ſuperficial *Meaſures* us'd for that Purpoſe; and though 'tis here carried to a *Mile*, yet 'tis ſeldom in Practice, carried farther than an *Acre*.

144 *Square Inches is* 1 *Square Foot.*
9 *Square Feet is* 1 *Square Yard.*
30 *Square Yards, and* ¼ *is* 1 *Square Pole.*
40 *Square Poles is* 1 *Square Rood.*
4 *Square Roods is* 1 *Square Acre.*
10 *Square Acres is* 1 *Square Furlong.*
64 *Square Furlongs is* 1 *Square Mile.*

## DRY MEASURE.

This is, or ought to be us'd in *Grain, Salt, Coals, Sand,* &c. and ought all to be *ſtruck,* as unground *Corn* is; but *Cuſtom* prevails both for the Mode of uſing and Bigneſs of the ſame *Meaſure,* in different Places, however in *London* they are moſt regarded.

2 *Pints is* 1 *Quart*; *and* 4 *Quarts, or* 8 *Pints, is* 1 *Gallon*; 2 *Gallons is* 1 *Peck*; 4 *Pecks is* 1 *Buſhel, Sand-Meaſure*; *and* 5 *Pecks* 1 *Buſhel, Water-Meaſure*; 8 *Buſhels is* 1 *Quarter*; 4 *Quarters,* 1 *Chaldron*; 5 *Quarters,* 1 *Wey*; *and* 2 *Weys,* 1 *Laſt.*

*N. B.* In *London,* 36 Buſhels of Sea-Coal is a Chaldron.

## WINE MEASURE.

By this Meaſure all *Wines, Brandies, Rum, Arrack,* and all other *Strong-Waters* or *Spirits,* are meaſured; as alſo *Mead, Perry, Cyder, Vinegar, Oil, Honey:* And in retailing them, all very ſtrong or *Fine-Ales,* ſuch as *Burton, Nottingham, Yorkſhire, Welſh,* &c. *Ales.* Now the Subdiviſions are as follows, *viz.*

2 *Pints is* 1 *Quart,* 2 *Quarts* 1 *Pottle,* 2 *Pottles* 1 *Gallon,* 18 *Gallons* 1 *Rundlet,* 31 *Gallons* ½ 1 *Barrel or* ½ *Hogſhead,* 42 *Gallons* 1 *Tierce, or half Punchion,* 63 *Gallons* 1 *Hogſhead,* 84 *Gallons* 1 *Puncheon,* 2 *Hogſheads* 1 *Pipe or Butt, and* 2 *Pipes* 1 *Ton.*

Here you are to *Note,* That this *Gallon* ought to contain 231 *Solid Inches* in Meaſure, and which, of pure *Rain-Water,* ſhould weigh 8 *Pounds,* 1 *Ounce,* 11 *Drams,* Avoirdupoiſe-Weight, or 9 *Pounds* 10 Ounces 1 *Penny Weight,* and ¼ Troy-Weight.

BEER

## BEER or ALE MEASURE.

*Here* 2 *Pints make* 1 *Quart*, 4 *Quarts* 1 *Gallon*, 8 *Gallons* 1 *Firkin of Ale*, 9 *Gallons* 1 *Firkin of Beer*, 2 *Firkins of Beer a Kilderkin*, 2 *Kilderkins a Barrel*, *and* 1 *Barrel and* ½ *a Hogſhead*, *and* 2 *or* 3 *Barrels Hogſheads a Butt.*

In this *Meaſure* 282 *Solid Inches* are a *Gallon*, and of pure *Rain-Water* weighs 10 *Pounds*, 3 *Ounces* and 7 *Drams*, Avoirdupoiſe Weight. *Note*, 'Tis only in *London*, and within the *Bills* of *Mortality*, that the above Diviſions are obſerv'd; in all other Parts of the Kingdom the *Beer* and *Ale* are gauged by one Meaſure, *viz.* 34 *Gallons* to a *Barrel*, 17 to a *Kilderkin*, and 8½ to a *Firkin.*

## TROY WEIGHT.

This is the oldeſt, and the original ſettled regular Weight in *England*, and taken from a Grain of Wheat, full ripe, and well dried; for which Reaſon the ſmalleſt Subdiviſion was, and ſtill is call'd a *Grain*; 32 of theſe Grains at firſt, made another Weight, call'd *a Penny Weight*, or weigh'd ſo much as the *Silver*, that at that Time went for a *Penny*. *See* the Statute of 51 *Hen.* 3. But 32 being not ſo fit a *Number*, to be exactly divided into a large Number of *Aliquot Parts*, as ½, ⅓, ¼, ⅙, *&c.* the 32 was chang'd into 24, as it now ſtands; that is, the preſent *Grain*, is 1 and a third Part of the *original Grain*, or three of theſe preſent *Grains*, is equal to 4 of the *original Ones.* Now by this *Weight* all fine Goods, ſuch as *Gold*, *Silver*, *Pearls*, *phyſical Potions* and *Bread* were weigh'd; but by a late *Statute*, *Bread* is weigh'd by the *Common* or *Avoirdupoiſe Weight.*

In *Troy Weight* 32 natural or 24 artificial *Grains make* 1 *Penny Weight*, 20 *Penny Weights make* 1 *Ounce*, *and* 12 *Ounces make* 1 *Pound.* Now although *Medicines* are weigh'd by this *Weight*, yet the *Apothecaries* divide it as follows, viz. 20 *Grains make* 1 *Scruple*, *mark'd thus* ℈; 3 *Scruples make* 1 *Dram*, *mark'd thus* ʒ; *and* 8 *Drams make* 1 *Ounce*, *mark'd thus* ℥; *and* 12 *Ounces make* 1 *Pound*, *mark'd thus* ℔; and this is particularly call'd APOTHECARIES WEIGHT.

## AVOIRDUPOISE WEIGHT.

This is ſaid to come from the *French* Words, AVOIR DU POISE, ſignifying, to be heavier or more than Weight; and

and this is us'd in all ſuch Goods, where there is any Waſte or Loſs by Droſs, Duſt, Skins, *&c.* whoſe Subdiviſions are as follows, *viz.*

16 *Drams make* 1 *Ounce*, 16 *Ounces make* 1 *Pound*, 28 *Pounds make* 1 *Quarter of a Hundred*, 4 *Quarters* 1 *Hundred Weight*, *and* 20 *Hundreds are* 1 *Ton*; *the Marks us'd in this Weight are Tons* -€ ; ℔, *Oz. Dra.*

## TIME.

By this we meaſure the Length of our *Lives*, the *Periodick Revolutions* of the *Planets*, and the *Seaſons* of the *Year*, and compute the moſt remarkable Accidents of ancient as well as modern *Hiſtories:* To perform which, we ſuppoſe a *Circle*, and in the Center of that *Circle*, an *Index* ſo fix'd, that it moves orderly, regularly and ſucceſſively, equal Spaces continually; and for vulgar *Uſe*, we go no lower than *Seconds*, though you may conceive in your Mind, *Thirds*, *Fourths*, &c. But 'tis common to ſay or reckon 60 *Seconds for a Minute*, 60 *Minutes for an Hour*, 24 *Hours for a Day*, *and* 365 *Days for a common Year*, *and once in* 4 *Years* 366 *Days*; though this is about 10 *Minutes*, and 50 *Seconds* too much in each *Year*, yet as our *Superiors* have not thought fit to rectify it, we ſhall not contradict the commonly receiv'd Method, or vulgar Computation as now us'd, in which are the following Subdiviſions, *viz.*

60 *Seconds is a Minute*, 60 *Minutes is an Hour*, 24 *Hours is* 1 *Day*, 7 *Days is a Week*, 4 *Weeks is a Month*, *and* 13 *Months is a Year.*

But this wants a *Day* and 6 *Hours* of the *common Year*, which, by our *Almanacks*, is thus divided.

60 *Seconds is a Minute*, 60 *Minutes is an Hour*, 24 *Hours is a Day*; *and ſometimes* 28, 29, 30 *and* 31 *Days is a Month*; *and* 12 *of theſe unequal Months is a Year*, that is to ſay, *January*, *March*, *May*, *July*, *Auguſt*, *October* and *December*, have always 31 *Days*; *April*, *June*, *September* and *November*, have always 30 *Days*; and *February* for 3 *Years* ſucceſſively hath 28 *Days*, and the fourth *Year* 29 *Days.*

An *Example* or *two* will make all plain.

LAND MEASURE.

| *Acres* | | *Roods* (4) | | *Poles* (40) |
|---|---|---|---|---|
| 27 | : | 1 | : | 25 |
| 46 | : | 2 | : | 17 |
| 74 | : | 3 | : | 35 |
| 13 | : | 1 | : | 16 |
| 22 | : | 2 | : | 28 |
| 87 | : | - | : | 19 |
| 16 | : | - | : | 24 |
| 94 | : | 3 | : | 32 |
| 76 | : | 2 | : | 18 |
| 58 | : | - | : | 17 |
| 27 | : | - | : | 29 |
| 85 | : | 3 | : | 32 |
| 631 | : | - | : | 12 |

Here you may obſerve, that this *Example* may repreſent 12 *Fields*, or *Parcels* of *Land*, of which an *Eſtate*, or Part of one, may be imagined to conſiſt; ſo that upon *Surveying* and Caſting them up, they *amount* to 631 *Acres* and 12 *Poles* of *Land*, which may be worth much or little, as they ſhall be ſituated, or naturally fruitful. I have ſet 40 over the *Poles*, which in caſting up muſt not be reckon'd, that ſtanding only to remind you how many *Poles* make a *Rood*; and ſo the 4 over the *Roods* is only to keep in your Mind, that 4 *Roods* make an *Acre*. The *Acres* being here the laſt *Column*, or *whole Numbers*, muſt be reckon'd by 10, as muſt always the laſt *Column*, let the Name be what it will; as was obſerv'd before.

DRY MEASURE.

| *Quarters* | | *Buſh.* (8) | | *Pecks* (4) |
|---|---|---|---|---|
| 29 | : | 2 | : | 1 |
| 92 | : | 3 | : | 3 |
| 76 | : | 4 | : | 2 |
| 84 | : | 5 | : | 1 |
| 58 | : | 6 | : | 2 |
| 67 | : | 7 | : | 3 |
| 34 | : | 7 | : | 1 |
| 27 | : | 1 | : | 2 |
| 18 | : | 6 | : | 3 |
| 99 | : | 2 | : | 1 |
| 15 | : | 5 | : | 1 |
| 51 | : | 3 | : | 3 |
| 657 | : | - | : | 3 |

WINE MEASURE.

| *Hogſheads* | | *Gallons* (63) | | *Pints* (8) |
|---|---|---|---|---|
| 28 | : | 18 | * | 4 * |
| 95 | : | 32 | : | 2 |
| 64 | : | 46 | * | 1 |
| 38 | : | 19 | : | 5 * |
| 7 | : | 35 | * | 7 * |
| 9 | : | 16 | : | 1 |
| 6 | : | 28 | * | 3 |
| 18 | : | 27 | : | 4 * |
| 42 | : | 32 | : | 5 |
| 85 | : | 36 | * | 6 * |
| 67 | : | 48 | * | 7 * |
| 34 | : | 49 | * | 7 * |
| 91 | : | 52 | : | 6 |
| 591 | : | 04 | : | 2 |

BEER and ALE MEASURE.

| Barrels | Gall. (36) | Quarts (4) |
|---|---|---|
| 34 | 27. | 1. |
| 16 | 18 | 2 |
| 18 | 29. | 3 |
| 37 | 32. | 1. |
| 92 | 35. | 2 |
| 84 | 18. | 3. |
| 35 | 17 | 2 |
| 62 | 10 | 2. |
| 71 | 09. | 3. |
| 34 | 11 | 1 |
| 16 | 16 | 2 |
| 505 | 11 | 2 |

TROY WEIGHT.

| ℔ | Oz. (12) | Dwts. (20) | Gr. (24) |
|---|---|---|---|
| 92 | 11 | 16 | 21. |
| 84 | 10 | 17 | 16 |
| 77 | 09 | 13 | 18. |
| 66 | 07 | 18 | 19. |
| 38 | 08 | 19 | 17. |
| 42 | 11 | 14 | 16 |
| 98 | 10 | 12 | 18. |
| 89 | 07 | 13 | 12. |
| 76 | 08 | 16 | 13 |
| 67 | 09 | 17 | 15. |
| 54 | 11 | 18 | 19 |
| 7 792 | 9 02 | 9 00 | 16 |

AVOIRDUPOISE WEIGHT.

| Tons | C. (20) | Qr. (4) | ℔ (28) | Oz. (16) | Dra. (16) |
|---|---|---|---|---|---|
| 9 | 16. | 1 | 19. | 10. | 09. |
| 8 | -- | 2 | 18 | 11 | 10 |
| 7 | 10 | 3. | 16. | 12. | 15. |
| 6 | -- | 1 | 15. | 13. | 11. |
| 5 | -- | 2. | 19 | 14. | 12. |
| 4 | 12. | - | 11. | 15. | 14. |
| 3 | 15. | - | 13 | 14. | 13 |
| 2 | 19 | - | 27. | 08 | 09. |
| 1 | -- | 3. | 21. | 07. | 08. |
| 9 | -- | 1. | 19. | 09 | 10 |
| 8 | -- | 3. | 15 | 14. | 11. |
| 2 | 16. | - | 24. | 13. | 10 |
| 7 | -- | 2. | 16 | 07 | 07. |
| 6 | 18. | - | 18. | 11. | 09 |
| 82 | 12 | 3 | 09 | 07 | 04 |

TIME.

| Days | Hours (24) | Min. (60) | Sec. (60) |
|---|---|---|---|
| 16 | 16. | 36 | 47. |
| 31 | 13 | 29. | 32. |
| 42 | 12. | 18 | 18 |
| 71 | 18. | 19 | 29 |
| 34 | 19. | 48. | 39. |
| 18 | 21 | 29. | 49. |
| 16 | 14. | 31 | 59. |
| 15 | 22. | 39. | 21 |
| 19 | 18. | 42. | 31. |
| 87 | 23. | 54 | 41 |
| 24 | 21 | 16. | 51. |
| 36 | 18. | 39 | 18 |
| 418 | 05 | 47 | 15 |

You may divide these *Examples* into two or more Parts, and add the Parts separately, and then the *Sum* of those *Totals* will be the true *Total* of the Whole; as was shewn you in *Money*: Enough has been said of *Addition*. Now I shall go on to *Subſtraction*.

CHAP.

## CHAP. III.

### *Of the* Subſtraction *of* whole Numbers, *and alſo* thoſe *of various* Denominations.

SUBSTRACTION *is that Rule, by which the Difference between, or Exceſs of, any two Numbers or Quantities, are found out, or diſcovered.*

And *here*, as in *Addition*, you are to regard the *Order* of the *Places*, or *Degrees* of *Value*, of which the *Sums* or *Numbers* given conſiſt, and mind to put exactly under, and take the *Units* from the *Units*, the *Tens* from the *Tens*, the *Hundreds* from the *Hundreds*, &c. as you ſee done in the following *Examples*.

*His preſent Majeſty King* GEORGE II. *was born the* 30th *of* October, *in the Year* 1683. *How old is he, on his Birth-day this Year*, 1737?

Here, as in all other Caſes is common, I ſet down the largeſt Number uppermoſt, and exactly under it the ſmalleſt; as you ſee in the *Margin*: The *Numbers* being thus ſet down, take or ſubſtract the *Units* Place of the *loweſt Number* out of the *Units* Place of the *higheſt Number*, ſaying, 3 out of 7, remains 4; which I accordingly ſet down under the *Units* Place, and go on to the *Tens* Place, and ſay, 8 out of 3 I cannot, therefore I take 1 from the next Figure on the *Left-hand*, or *Hundreds* Place, which being 10 *Tens*, makes the 3 that ſtands in the *Tens* Place 13; then, I ſay, 8 out of 13, and the Remainder is 5, which I ſet down under the Place of *Tens*; then I go on, and ſay, 6 out of 6 (becauſe I had before taken 1 from the 7 to make the 3, 13) and there remains 0; then I go on, and ſay, 1 out of 1, and there remains 0: So that the whole Difference is 54, which was the *King*'s *Age*, the 30th of *October*, 1737. Again,

| | |
|---|---|
| 1737 | the preſent *Year*. |
| 1683 | the *Year* the *King* was born in. |
| .. 54 | the *King*'s Age. |
| 1683 | Proof by *Subſtraction*. |
| 1737 | Proof by *Addition*. |

Suppoſe a *King* borrows of his *Subjects* 632568 *Dollars*,
and pays them again - - - 587694

*How much is ſtill owing?* Anſwer, 44874 ſtill owing.

Proof by *Subſtraction* 587694

Proof by *Addition* 632568

Here the *Numbers* being firſt regularly ſet down under one another, as above directed, and as you ſee in the *Example*, I begin at the *Units* Place, and ſay, 4 from 8, remains 4; then, 9 from 6 I cannot, therefore I borrow 1 from the 5, or next *Figure* on the *Left-hand*, which makes the 6, 16; then I ſay, 9 from 16, remains 7; which I ſet down under the 9, or Place of *Tens*, and go on, ſaying, 6 from 4 I cannot; (Note, the Figure itſelf is 5, but I took away, or borrow'd 1 from it, to make the 6, 16; ſo that the 5 is now depreſſed, or become equal to 4) and therefore I take or borrow 1 from the next Figure towards the Left-hand, which here is 2, and the 4 becomes 14, becauſe every *Unit* or 1 on the *Left-hand* makes, or is equal to 10 *Units* or *Ones*, in the next Place to it on the *Right-hand*. Now 6 taken from, or out of 14, the Remainder is 8, which is here ſet down under the 6; then I go on and ſay, 7 from 1 (becauſe 1 was before borrow'd of, or taken from the 2) I cannot, and therefore I borrow 1 of, or take it from the 3, and the 1 becomes 11, and the 3 becomes 2, for the Reaſon above. Now 7 taken out of 11 leaves 4 for the Remainder, which I ſet down in the fourth Place, under the 7, and go on, ſaying, 8 out of 2 (becauſe I borrow'd or took 1 out of the 3, laſt Time) I cannot, therefore I borrow, or take 1 from the next Figure 6, to make this 2, 12; then I ſay, 8 out of 12, remains 4; which I ſet down in the 5's *Place* under 8, and go on and ſay, 5 out of 5 (becauſe 1 being taken from the 6, makes the Remainder 5) and there remains 0; ſo that I find *the Sum ſtill owing* is, 44,874 *Dollars*, the Truth of which may be prov'd by *ſubſtracting* this Remainder out of the whole Debt, and the Remainder will be *the Sum paid*; or you may *add* the *Sum* paid, and the *Sum* remaining due, and their *Total* will be the whole or original *Debt*; as may be ſeen by the two *Examples* above.

Again,

Again, Suppoſe I wanted to know the *Difference* between - - - - } 987654321
and - - - - 123456789

By working as before, the Anſwer will be found to be - - - - } 864197532

Again, Suppoſe an *Army* to conſiſt of 140000 *Men*, and that by *Death*, *Sickneſs*, and putting into *Gariſon* - - - - } 82345 were taken from it:

How many *ſtill remain* in the *Field?* Anſwer, } 57655

Here I begin, and ſay, 5 out of 0 I cannot, therefore 1 is borrow'd of, or taken from the next *Figure* or *Place* of *Tens*; and then I ſay, 5 out of 10, and there remain 5; then I go on to the next *Figure*, which is made 1 leſs, by borrowing from it, to increaſe that on the Right-hand 10; but the *Figure* itſelf being a 0, I go on to the 3d *Figure*, which is alſo a 0; ſo I go on to the 4th *Figure*, which is alſo a 0; therefore I go on to the 5th *Figure*, towards the *Left-hand*, which is the firſt ſignificant *Figure*, which here is the Figure 4; from which taking 1, it will be depreſs'd to 3, and the 2d, 3d, and 4th *Figures* will become 9's; for when I borrowed *Ten* to add to the *firſt* 0, I could not take it out of 0, the ſecond Figure, therefore I was forc'd to go on to the next *Figure* to borrow 10 from the *Hundreds Place*; but that being likewiſe a 0, I went to the next *Figure* or *Thouſands Place*, to take the 10 from thence; but that being alſo a 0, I was ſtill forc'd to go on one *Figure* farther, which was the 5th *Place*, or *Tens* of *Thouſands*; and there taking 1, or 10 *Thouſand* out of the 4, or 40 *Thouſand*, the Remainder of that 1, or 10,000, was conſequently 9990; from which, taking the *Figures* underneath the 2d, 3d, and 4th Places, and ſetting down the Remainder, I come to the 5th *Place*; and though the *Figure* that ſtands in that Place in the uppermoſt *Line*, is a 4, or 40,000, yet I muſt call it but 3, becauſe it has lent one of its Parts or *ten Thouſands* to the foregoing *Figures*; therefore I ſay, 8, which is the 5th Figure towards the *Left-hand*, in the *under Row*, out of 3, (*viz.* the Remainder after 1 is taken out of the 4) I cannot; therefore I borrow 1 which is 10, from the 6th *Place*, and it makes 13; then I ſay,

I ſay, 8 from 13, and the Remainder is 5; then I go on to the 6th *Place*, but find no ſignificant *Figures* left, becauſe the 1 that ſtands in the 6th or laſt Place, was taken away or borrowed to be added to the 3, that remained after 1 was taken from the 4 in the 5th *Place*.

| | | |
|---|---|---|
| Again, Suppoſe from | 7850006590001237 | What Remains? |
| I *take* or *ſubſtract* - | 6971230004567895 | |
| Anſwer, | 0878776585433342 | |
| Proof by *Addition* - | 7850006590001237 | |
| Proof by *Subſtraction* | 6971230004567895 | |

Here I begin, and ſay, 9 from 3 I cannot, but 9 from 13, remains 4; and as I borrowed or took away 1 from the 2, which is the next Figure towards the *Left-hand*, that becomes 1; then I ſay, 8 from 1 I cannot, therefore I borrow 1 from the next *Figure*, towards the *Left-hand* (which is always 10 in Value, of thoſe next to it on the *Right-hand*, let it be the 2d, 3d, 4th, 5th, or any other *Place* or *Figure*, as has often already been noted) which being put, or ſuppoſed to be put on the *Left-hand*, makes the 2 that muſt now be called 1, become 11, and taking the 8 out of it, there remains 3; then I go on and ſay, 7 from 0 (becauſe the next Figure which is 1, had 1 taken from it, to add to the former Figure to make it 11) I cannot; ſo I borrow 1, which is 10, as above, and ſay 7 from 10, there remains 3; then I go on and ſay, 6 from 9, and there remains 3; then 5 from 9, and there remains 4; then 4 from 9, and there remains 5, becauſe the three 0's that ſtand in the 4th, 5th, and 6th Places cannot lend any thing, therefore I was oblig'd to go to the firſt ſignificant *Figure*, and which here is 9, to lend 1, or 10, to the 1, that was depreſſed to a 0, and thereby it is depreſſed to 0, (and the 3 *Cyphers* become all 9's, for the ſame Reaſon, as above in the laſt *Example*) ſo that I go on, and ſay, 0 from 8, and there remains 8; and 0 from 5, and there remains 5; and 0 from 6, and there remains 6; then 3 from 0 I cannot, therefore I borrow 1 from the next Figure, and ſay, 3 from 10, and there remains 7; but as the two next Figures are alſo 0's, I go on as before, to the firſt next ſignificant *Figure* on the *Left-hand*, which here is 5, and borrow of, or take

take 1 from it, ſo that you muſt call it but 4, when you come to it; and the two Cyphers that ſtand next it, on the Right-hand, you muſt call 9's, as before; ſo that I go on, ſaying, 2 from 9, remains 7; and 1 from 9, remains 8; and then inſtead of ſaying 7 from 5, I ſay, 7 from 4 (for the Reaſon above) I cannot, but borrowing 1 from the 8, I ſay, 7 from 14, and there remains 7; then 9 from 7 (becauſe the 8 has 1 taken from it) I cannot, but borrowing 1 from the 7, 9 from 17, and there remains 8; and now I am come to the laſt Figure, I ſay, 6 from 6, (becauſe 1 was taken from the 7 before) and there remains 0; ſo that I have now got 878776585433 34 for the *Remainder* or Difference between the two given *Numbers*. Now to know whether my Work is right, I *ſubſtract* this *Remainder* from the biggeſt given *Number*, and find the *Remainder* to be 6971230004567 89, the ſame with the leaſt given Number; or you may add the Remainder, firſt found, to the leaſt given Number, and the *Total* will be the ſame with the biggeſt given Number; as appears by the *Example* above: However, to take away all Doubt, let the biggeſt given Number, 7850006590001 23, be ſet down again, and

| | | |
|---|---|---|
| under it the Remainder firſt found will be | 878776585433 34<br>6971230004567 89 | *Subſtract* the leſſer from the greater, and the *Rem.* |

For beginning at the firſt Figure, or Units Place, I ſay, 4 from 3 I cannot, but 4 from 13, and there remains 9; then I go on and ſay, 3 from 1, (becauſe I took 1 from the 2, to make the 3, 13) I cannot, but 3 from 11 (borrowing from the 1 on the *Left-hand*) and there remains 8; which being ſet down, I go on and ſay, 3 from 0 (becauſe 1 taken from the 1 makes it 0) I cannot, therefore I borrow 1 of the next Figure on the Left-hand, (which here, being 0's for 3 Places together, I muſt go on to the firſt ſignificant Figure, and take 1 from thence, which here is 9; ſo that the 9 becomes 8, and all the 0's 9's, as is ſaid above) and it makes the 1, that is now become 0, 10; then I ſay, 3 from 10, and there remains 7; and 3 from 9, and there remains 6; and 4 from 9, and there remains 5; and 5 from 9, and there remains 4; and 8 from 8 (becauſe the 9 has had 1 taken out of it) and there remains 0; and 5 from 5, and there remains 0; and 6 from 6, and there remains 0; then 7 from 0 I cannot, but borrow as before;

then

then 7 from 10, and there remains 3; and 7 from 9, and there remains 2; and 8 from 9, and there remains 1; and 7 from 4 (becauſe 1 was taken from the 5, to make good the Deficiency of the 0's) I cannot, but 7 from 14, and there remains 7; then 8 from 7 (becauſe 1 was taken from the 8 to make the laſt *Figure* 4, 14) I cannot, but borrowing 1 from the next *Figure*, which is 7, the 8 that is now depreſſed to 7, becomes 17; ſo that the Remainder will be 9; and as there is now no more Figures to ſubſtract, I ſay, 0 out of 6, (becauſe the laſt Figure 7, in the *upper Line*, had 1 taken from it,) and there remains 6; ſo that the Remainder is now 697123000456789, the ſame with the leſſer given Number; which ſhews that the Work is rightly performed. I have now fully explained the Method of ſubſtracting one whole Number from another; I ſhall only obſerve to you, that there is no abſolute Neceſſity for putting the biggeſt Number uppermoſt; but if you ſhould have any ſuch *Example* given you, where the leaſt Number ſhould be uppermoſt, you muſt be ſure always to take the leſſer Number from the greater, let them ſtand how they will; for 'tis impoſſible to take a bigger Number from a leſſer; as you may readily ſee by the Examples following.

| | Or | | Or | | Or | | &c. |
|---|---|---|---|---|---|---|---|
| 23 | | 72 | | 732 | | 1234, | |
| 87 | | 98 | | 918 | | 5678 | |
| 64 | | 26 | | 186 | | 4444 | |

Here 'tis very plain, that neither of the under Lines can be taken out of the upper Lines; and therefore if any thing is to be done, you muſt take the upper Lines out of the under Ones; the ſeveral Remainders or Differences will be as you ſee in the ſeveral *Examples*.

Suppoſe from *London* to *Berwick* is 265 *Miles* by Computation, and I travel as follows, The firſt Day to *Ware*, which is 20 *Miles*; the ſecond Day to *Huntingdon*, which is 28 *Miles* more; the third Day to *Grantham*, which is 35 *Miles* more; the fourth Day to *Doncaſter*, which is 38 *Miles* more; the fifth Day from thence to *York*, which is computed 29 *Miles* more: *How far am I from my Journey's End?* The Queſtion ſuppoſes the ſeveral Places mentioned to be in the direct Road to *Berwick*, and conſequently every Day's Journey diminiſhes the Diſtance to be travelled; and therefore to anſwer this, or any ſuch like Queſtion,

you may ſet down the ſeveral Diſtances travelled, and add them all together, and ſubſtract their Total from the whole Diſtance; and what remains is the Anſwer ſought, as follows,

| | *Miles.* |
|---|---|
| Firſt Day's Journey from *London* to *Ware* | 20 |
| Second Ditto from *Ware* to *Huntingdon* | 28 |
| Third Dit. from *Huntingdon* to *Grantham* | 35 |
| Fourth Dit. from *Grantham* to *Doncaſter* | 38 |
| Fifth Ditto from *Doncaſter* to *York* | 29 |

150 Travelled
265 the whole Jour.

115 ſtill to go.

Or, you may ſet down the whole Diſtance 265, and ſubſtract every Day's Journey thus; 20 the firſt *Day's* Journey.

245 remains.
28 the ſecond *Day's* Journey.

217 remains.
35 the third *Day's* Journey.

182 remains.
38 the fourth *Day's* Journey.

144 remains.
29 the fifth *Day's* Journey.

115 remains ſtill to go.

By the working this Example both Ways, you ſee the Reſult is the ſame, and in all ſimilar or like Caſes, muſt neceſſarily be ſo; for 'tis the ſame thing to continually ſubſtract the Parts or Numbers from the Whole, as to add them up, and ſubſtract their Total from the Whole; as appears by the Work before you. Now I will go on to the *Subſtraction* of *Money*, *Weights*, *Meaſures*, &c. in which you will note, that the ſame *Numbers* you *ſtopt* or *reckon'd* by, in *Addition*, as *Occaſion* requires, you muſt *borrow* in *Subſtraction*.

*Example* 1. MONEY.

| | *l.* | *s.* | *d.* | *q.* |
|---|---|---|---|---|
| From - - | 316 : | 13 : | 10 | ½ |
| Take - - | 159 : | 18 : | 08 | ¼ |
| Remains - - | 156 : | 15 : | 01 | ¼ |
| Proof by *Subſtraction* | 159 : | 18 : | 08 | ¼ |
| Proof by *Addition* | 316 : | 13 : | 10 | ½ |

*Example* 2.

| | *l.* | *s.* | *d.* | *q.* |
|---|---|---|---|---|
| From - - | 2008 : | 17 : | 04 | ¼ |
| Take - - | 1234 : | 05 : | 06 | ¼ |
| Remains - - | 774 : | 11 : | 10 | ½ |
| Proof by *Subſtraction* | 1234 : | 05 : | 06 | ½ |
| Proof by *Addition* | 2008 : | 17 : | 04 | ¼ |

Here I begin with the firſt *Example*, and ſay, 3 Farthings out of 2 Farthings I cannot, therefore I take a Penny from the Pence, and ſay, 3 Farthings out of a Penny leaves 1 Farthing; which with the 2 Farthings that are already given, makes 3 *Farthings*, to be ſet down under the *Farthings*, as you ſee done in the *Example*; then I go on to the Pence, and ſay, 8 out of 9 (becauſe I took 1 from the 10 *Pence*, to *add* to the *Farthings*) and there remains 1 Penny to be ſet down; then I go on to the Shillings, and ſay, 18 from 13 I cannot, and therefore I borrow 1 *Pound* or 20 *Shillings* from the Figure that ſtands in the Units Place of the *Pounds*, *viz.* the 6, and ſay, 18 out of 20, and there remains 2; which with the 13 *Shillings* given, makes 15, to be ſet down under the *Shillings*; then I go on to the *Pounds*, and ſay, 9 from 5 (becauſe 1 was taken from the 6 to add to the *Shillings*,) I cannot, but borrowing 1 from the ſecond Figure, or 1, the 5 becomes 15; ſo that the Remainder is 6; which being ſet down, I ſay, 5 from 0 I cannot, (becauſe 1 being taken from the 1, leaves 0) but borrowing 1, 'tis then 5 from 10, and the Remainder is 5; then 1 from 2 (becauſe

(becauſe 1 was borrowed or taken from the 3) and there remains 1; ſo that the whole Remainder is *L.* 156 : 15 : 01 ¼.

*Note*, That as in *Addition*, the *Figures* of the laſt *Column* or whole *Numbers*, were always added, by conſidering them as if they were ſimply Numbers, without any Name; ſo in *Subſtraction* you muſt always do the like, as you ſee by the laſt *Example*.

For the *Proof* of your Work, you may do as was before directed in whole *Numbers*, viz. *ſubſtract* the *Remainder* found, out of the greater *Number* given, and the ſecond *Remainder* will be the ſame with the *leſſer* Number given, as is done in this firſt *Example*; for I ſay, 3 *Farthings* out of 2 *Farthings*, I cannot, but borrowing 1 *Penny* or 4 *Farthings* from the 10 *Pence*, it makes the 2 *Farthings* 6; from which taking the 3, the *Remainder* is alſo 3; which being ſet down, I go on and ſay, 1 *Penny* from 9 Pence (becauſe 1 was taken from the 10 to *add* to the *Farthings*; ſo that there is but 9 left) and the *Remainder* is 8; which I ſet down, and go to the *Shillings*, ſaying, 15 from 13, (becauſe I did not borrow a *Shilling* to add to the *Pence*; ſo that the 13 *Shillings* were not diminiſhed) I cannot, therefore I borrow 1 *Pound*, or 20 *Shillings*, from the *Figure* that ſtands in the *Units* Place of the *Pounds*, which being *added* to the 13, makes 33; then 15 out of 33, leaves 18 *Shillings* to be ſet down under the *Shillings*; then I go on, and ſay, 6 from 5 I cannot, but 6 from 15, remains 9; which being ſet down, I ſay, 5 from 0 I cannot, but 5 from 10, remains 5; and 1 from 2, remains 1; ſo that the whole *Remainder* now is, *L.* 159 : 18 : 08 ¾, the ſame with the leaſt given *Number*; from whence 'tis evident the Work is right, for the greateſt given Number may be conſidered as ſome whole *Sum* or *Number*; and the leſſer given *Number*, and the *Remainder*, as two Parts of the ſaid biggeſt given *Number*; which two Parts, when *added* together, will make, or be equal to the ſaid biggeſt given *Number*, as you ſee done in the ſecond *Proof* of this *Example*, where the two *Remainders* being *added* together, the *Sum* is *L.* 316 : 13 : 10 ½, the ſame with the biggeſt given *Number*. The ſecond *Example* is done in the ſame Manner; for beginning at the *Farthings*, I ſay, 1 *Farthing* from 3 Farthings, and there remains 2 *Farthings*; which being ſet down under the *Farthings*, I go on and ſay, 6 *Pence* from 4 Pence I cannot, therefore I borrow 1 *Shilling*, or 12 *Pence*, from the 17 Shillings, and ſay, 6 from 12 and there remains 6, which added to the 4, makes 10;

or you may *add* the 12 *Pence* that are in the 1 *Shilling* you borrow'd, to the 4, and they make 16; then take 6 out of the 16, and the *Remainder* will be 10, as before; which being ſet down, I go to the Shillings, and ſay, 5 from 16, (becauſe 1 was taken from 17 to *add* to the *Pence*) and there remains 11; now as I borrow'd nothing, I go on to the *Pounds*, and ſay, 4 from 8, and there remains 4; then 3 from 0 I cannot, but 3 from 10, and there remains 7; then 2 from 9, and there remains 7, and 1 from 1 (becauſe 1 was taken from the 1 to help the 0, as has been taught you before) and there remains 0. Now as a 0 on the *Left-hand* of *whole Numbers*, neither increaſes nor diminiſhes the *Numbers*, therefore 'tis needleſs to ſet a 0 down in that Place; ſo that I find the whole *Remainder* to be *L.* 774 : 11 : 10 ½; for the Proof whereof you may *ſubſtract* this Remainder from the biggeſt *Number* given, ſaying thus; 2 *Farthings* from 3 *Farthings*, and there remains 1 *Farthing*; then 10 *Pence* from 4 *Pence* I cannot, but borrowing 1 Shilling or 12 Pence from the 17 *Shillings*, I ſay, 10 from 12, and there remains 2, which *added* to the 4, makes 6 to be ſet down under the *Pence*; then I go on and ſay, 11 *Shillings* from 16 *Shillings* (becauſe 1 is taken from 17) and there remains 5 Shillings; here borrowing *nothing*, I go on and ſay, 4 from 8 and there remains 4; then 7 from 0 I cannot, but 7 from 10, and there remains 3; then 7 from 9, and there remains 2, and 0 from 1 (becauſe 1 has already been taken from the 2 to help the 0's) and there remains 1; ſo that the whole Remainder is now *L.* 1234 : 05 : 06 ¼, which is the ſame with the *leſſer* given *Number*; from whence I conclude the Work to be right: Or, if you *add* the 2 *Remainders* together, their *Sum* or *Total* will be *L.* 2008 : 17 : 04 ¼, the biggeſt *Number* given, which is another Proof of the Truth of the Work; after the ſame Manner may the *Difference* between any *bigger* and *leſſer Number* be found. Again,

Suppoſe

Suppoſe a *Merchant* has *bought* or *contracted* for *Goods* to the *Amount* of - - - - *L.* 5816 : 13 : 10 ½

And at ſeveral Times has made theſe Payments following - -

| | | | |
|---|---|---|---|
| 1239 | : 18 | : — | - |
| 571 | : 16 | : 10 | ½ |
| 48 | : 11 | : 11 | ¼ |
| 65 | : 17 | : 10 | ¼ |
| 2796 | : 10 | : -- | - |
| 419 | : 18 | : 11 | - |

*How much is ſtill unpaid?*

Here you may *add* the ſeveral *Sums* paid together and *ſubſtract* their *Total* from the whole *Amount*, and the *Remainder* will be the *Sum* ſtill *due*; as you ſee done in this *Example*, where the *Total* of the *Sums* paid is *L.* 5142 : 13 : 7 ½; which being *ſubſtracted* from the whole *Sum* due, the *Remainder* is *L.* 674 : -- : 3.

*Total* paid 5142 : 13 : 7 ½

*Remains* 674 : -- : 3 unp.

Proof by *Ad.* 5816 : 13 : 10 ½

Or, you may ſet down the whole *Sum* and *ſubſtract* each particular *Sum* paid, thus: - -

*L.* 5816 :: 13 : 10 ½

1239 : 18 : -- the 1ſt Sum paid.

I would adviſe you to ſubſtract the particular *Sums* paid, as you ſee done in this *Example*, which will render you quite perfect in any thing that you can poſſibly want of this Kind, eſpecially if you tranſpoſe your *Numbers* and go backwards, ſubſtracting your laſt *Payment* firſt, and your firſt *Payment* laſt, *&c.* by which means you will have as much Variety, by this one *Example*, as if you had ever ſo many; and the laſt *Remainder* always coming to *L.* 674 : -- : 3, will be a Proof of the Truth of the whole Work.

| | |
|---|---|
| 4576 : 15 : 10 ½ | *remains* due. |
| 571 : 16 : 10 ½ | the 2d Payment. |
| 4004 : 19 : -- | *remains* due. |
| 48 : 11 : 11 ¼ | the 3d Payment. |
| 3956 : 7 : -- ¼ | *remains* due. |
| 65 : 17 : 10 ¼ | the 4th Payment. |
| 3890 : 09 : 2 - | *remains* due. |
| 2796 : 10 : -- | the 5th Payment. |
| 1093 : 19 : 2 - | *remains* due. |
| 419 : 18 : 11 - | the 6th Payment. |
| 674 : -- : 3 | *rem.* due as before. |

In the *Subſtraction* of *Weights*, *Meaſures*, *Time*, &c. the ſame *Method* is to be obſerv'd, regarding only how many

many of the leſſer Names on the *Right-hand* make 1 of the bigger *Names* on the *Left-hand*; as follows,

## CLOTH-MEASURE.

| | (4) (4) | | | (5) (4) | |
|---|---|---|---|---|---|
| | *Yards* | *Q.* | *N.* | *E.E.* | *Q.* *N.* |
| From | 25866 | : 2 | : 1 | 279 | : 1 : 3 |
| Take | 17892 | : 3 | : 2 | 186 | : 4 : - |
| Remains | 7973 | : 2 | : 3 | 92 | : 2 : 3 |
| Proof by *Addition* | 25866 | : 2 | : 1 | 279 | : 1 : 3 |
| Proof by *Subſtract.* | 17892 | : 3 | : 2 | 186 | : 4 : - |

| | (3) (4) | | | (6) (4) | |
|---|---|---|---|---|---|
| | *E.F.* | *Q.* | *N.* | *A.F.* | *Q.* *N.* |
| From | 678 | : 1 | : 1 | 927 | : 1 : 2 |
| Take | 592 | : 2 | : 3 | 672 | : - : 1 |
| Remains | 85 | : 1 | : 2 | 255 | : 1 : 1 |
| Proof by *Addition* | 678 | : 1 | : 1 | 927 | : 1 : 2 |
| Proof by *Subſtract.* | 592 | : 2 | : 3 | 672 | : - : 1 |

Here I have ſet 4 over the *Nails*, viz. ſo many as make a *Quarter*, and over the *Quarters* 4 alſo, becauſe ſo many make a *Yard*; over the *Engliſh Ell* 5; over the *Flemiſh-Ell* 3; and over the *French-Ell* 6; and then ſuppoſe I begin with the firſt *Example* on the *Left-hand*, which is *Yards*, *Q. N.* there I begin at the *Nails*, and ſay, 2 out of 1 I cannot, but borrowing 1 Quarter, which is 4 *Nails*, I ſay, 2 out of 5 (which is the *Sum* of the 4 *Nails* I borrowed, added to the 1 that is given) and there remains 3; then I go on and ſay, 3 *Quarters* out of 1 Quarter (becauſe 1 *Quarter* was taken from, or borrowed of the 2 Quarters that are given, which reduces the 2 given Quarters to 1) I cannot, ſo I borrow 1 Yard from the *Units* Place of the *Yards*, which is 4 *Quarters*, and the 1 that remains out of the 2 Quarters that are given, make 5 *Quarters*; then 3 out of 5, and there remains 2, which being ſet down under the *Quarters*, I go on and ſay, 2 Yards out of 5 *Yards* (becauſe 1 Yard was taken from the 6 Yards that ſtands in the Units

Units Place of *Yards*, to add to the 1 Quarter that was left out of the 2 given Quarters) and there remains 3; then I go on, as in whole *Numbers* has already been taught: The Proof may be, by adding the *Remainder* to the *lesser* given *Number*, and the *Sum* or *Total* must be *equal* to, or the *same* with, the biggest given Number; as you see by the *Examples* above: Or you may *substract* the *Remainder* first found, out of the *biggest* given *Number*; and the new Difference or Remainder, thus found, will be equal to, or the same with, the *least* given *Number*; as also appears by the same *Examples*.

## TROY-WEIGHT.

| | | (12) | (20) | (24) |
|---|---|---|---|---|
| | ℔ | *Oz.* | *Dwts.* | *Gr.* |
| From | 98762 | : 10 | : 19 | : 17 |
| Take | 47158 | : 11 | : 16 | : 22 |
| Remains | 51603 | : 11 | : 02 | : 19 |
| Proof by *Substraction* | 47158 | : 11 | : 16 | : 22 |
| Proof by *Addition* | 98762 | : 10 | : 19 | : 17 |

| | | (12) | (20) | (24) |
|---|---|---|---|---|
| | ℔ | *Oz.* | *Dwts.* | *Gr.* |
| From | 50000 | : 07 | : 09 | : 15 |
| Take | 31791 | : 09 | : 13 | : 17 |
| Remains | 18208 | : 09 | : 15 | : 22 |
| Proof by *Substraction* | 31791 | : 09 | : 13 | : 17 |
| Proof by *Addition* | 50000 | : 07 | : 09 | : 15 |

## AVOIRDUPOISE-WEIGHT.

| | | (20) | (4) | (28) | (16) | (16) |
|---|---|---|---|---|---|---|
| | *Tons* | *C.* | *Q.* | ℔ | *Oz.* | *Dra.* |
| From | 17001 | : 13 | : 1 | : 16 | : 05 | : 09 |
| Take | 9123 | : 14 | : 1 | : 27 | : 04 | : 07 |
| Remains | 7877 | : 18 | : 3 | : 17 | : 01 | : 02 |
| Proof by *Addition* | 17001 | : 13 | : 1 | : 16 | : 05 | : 09 |
| Proof by *Substraction* | 9123 | : 14 | : 1 | : 27 | : 04 | : 07 |

| | | (4) | (28) | (16) | (16) |
|---|---|---|---|---|---|
| | | *C.* | *Q.* | ℔ | *Oz.* | *Dr.* |
| From | 271 | 1 | 13 | 12 | 05 |
| Take | 159 | 3 | 17 | 15 | 09 |
| Remains | 111 | 1 | 23 | 12 | 12 |
| Proof by *Addition* | 271 | 1 | 13 | 12 | 05 |
| Proof by *Subſtraction* | 159 | 3 | 17 | 15 | 09 |

## APOTHECARIES WEIGHT.

| | | (12) | (8) | (3) | (20) |
|---|---|---|---|---|---|
| | | ℔ | ℥ | ℥ | ℈ | *Gr.* |
| From | 715 | 05 | 3 | 1 | 13 |
| Take | 615 | 05 | 4 | 2 | 17 |
| Remains | 99 | 11 | 6 | 1 | 16 |
| Proof by *Subſtraction* | 615 | 05 | 4 | 2 | 17 |
| Proof by *Addition* | 715 | 05 | 3 | 1 | 13 |

| | | (12) | (8) | (3) | (20) |
|---|---|---|---|---|---|
| | | ℔ | ℥ | ℥ | ℈ | *Gr.* |
| From | 200 | -- | - | 1 | 12 |
| Take | 198 | 10 | 2 | 1 | 16 |
| Remains | 1 | 01 | 5 | 2 | 16 |
| Proof by *Subſtraction* | 198 | 10 | 2 | 1 | 16 |
| Proof by *Addition* | 200 | -- | - | 1 | 12 |

## LONG MEASURE.

| | | (8) | (40) | (11) | (18) | (3) |
|---|---|---|---|---|---|---|
| | | *Miles* | *Fur.* | *Poles* | ½ *Yds* | *Inch.* | *Bar.C.* |
| From | 6273 | 07 | 16 | 05 | 13 | 1 |
| Take | 6263 | 07 | 16 | 05 | 13 | 2 |
| Remains | 9 | 07 | 39 | 10 | 17 | 2 |
| Proof by *Addition* | 6273 | 07 | 16 | 05 | 13 | 1 |
| Proof by *Subſtraction* | 6263 | 07 | 16 | 05 | 13 | 2 |

LAND

## LAND or SQUARE MEASURE.

| | Acres | (4) Rood | (40) Perches | Acres | Rood | Perch. |
|---|---|---|---|---|---|---|
| From | 7152 | 1 | 15 | 915 | 3 | 27 |
| Take | 6252 | 1 | 27 | 827 | 1 | 15 |
| Remains | 899 | 3 | 28 | 88 | 2 | 12 |
| Proof by *Subſtract.* | 6252 | 1 | 27 | 827 | 1 | 15 |
| Proof by *Addition* | 7152 | 1 | 15 | 915 | 3 | 27 |

## DRY MEASURE.

| | Chal. | (12) Sacks | (3) Buſh. | (4) Pecks |
|---|---|---|---|---|
| Bought | 5927 | 08 | 1 | 2 |
| Sold | 4629 | 11 | 2 | 3 |
| Remains unſold | 1297 | 08 | 1 | 3 |
| Proof by *Addition* | 5927 | 08 | 1 | 2 |
| Proof by *Subſtraction* | 4629 | 11 | 2 | 3 |

| | Chal. | (36) Buſh. | (4) Pecks | (16) Pints |
|---|---|---|---|---|
| Bought | 574 | 17 | 1 | 13 |
| Sold | 489 | 31 | 2 | 14 |
| Remains unſold | 84 | 21 | 2 | 15 |
| Proof by *Addition* | 574 | 17 | 1 | 13 |
| Proof by *Subſtraction* | 489 | 31 | 2 | 14 |

## BEER and ALE-MEASURE.

| | Buts Beer | (3) Bar. | (36) Gall. | (8) Pints | Bar. Ale | (32) Gal. | (4) Quarts. |
|---|---|---|---|---|---|---|---|
| Bought | 58 | 1 | 17 | 4 | 671 | 18 | 1 |
| Sold | 58 | 1 | 13 | 7 | 527 | 19 | 3 |
| Remains | 00 | 0 | 03 | 5 | 143 | 30 | 2 |
| Proof by *Subſtract.* | 58 | 1 | 13 | 7 | 527 | 19 | 3 |
| Proof by *Addition* | 58 | 1 | 17 | 4 | 671 | 18 | 1 |

## WINE-MEASURE.

| | | (4) | (63) | (4) | (2) |
|---|---|---|---|---|---|
| | *Tuns* | *Hogſh.* | *Gall.* | *Qts.* | *Pints.* |
| Bought | 69 | 2 | 17 | 1 | 1 |
| Sold | 42 | 3 | 49 | 3 | 1 |
| Remains unſold | 26 | 2 | 30 | 2 | 0 |
| Proof by *Addition* | 69 | 2 | 17 | 1 | 1 |
| Proof by *Subſtract.* | 42 | 3 | 49 | 3 | 1 |

## TIME.

| | | (24) | (60) |
|---|---|---|---|
| | *Days* | *Hours* | *Minutes.* |
| From | 719 | 13 | 52 |
| Take | 493 | 17 | 27 |
| Remains | 225 | 20 | 25 |
| Proof by *Subſtraction* | 493 | 17 | 27 |
| Proof by *Addition* | 719 | 13 | 52 |

| | | (365) | (24) | (60) | (60) |
|---|---|---|---|---|---|
| | *Com. Years,* | *Days,* | *Hours,* | *Min.* | *Seconds.* |
| From | 712 | 107 | 17 | 13 | 16 |
| Take | 691 | 218 | 19 | 58 | 42 |
| Remains | 20 | 253 | 21 | 14 | 34 |
| Proof by *Subſtraction* | 691 | 218 | 19 | 58 | 42 |
| Proof by *Addition* | 712 | 107 | 17 | 13 | 16 |

Having now gone through the ſeveral *Weights* and *Meaſures*, &c. the ſame *General Rule* muſt be obſerved in all of them, in *taking* or *ſubſtracting* the *leſſer* given *Line* or *Number* out of the greater; and always when the *Subſtraction* cannot be made out of the given *Figures*, as they ſtand, you muſt borrow 1 of the next ſuperior *Denomination*, and adding that to the given *Figures*, in the *lower* Name, take or ſubſtract the given *Figures* in the leſſer *Line* from that

*Total*, and ſet down the *Remainder*, as you ſee done in all the *Examples* above; and when the *Number* of *Parts* run high, 'twill be beſt to *add* and *ſubſtract* upon a Bit of *Waſte-Paper*, to prevent *Blots* and *Miſtakes*; as in the laſt *Example* of *Time*, I begin and ſay, 42 Seconds out of 16 I cannot; therefore I borrow 1 from the *Minutes*, which being 60 Seconds, I ſet it down, and under it the 16, that is already there; and *add* them together, and their *Sum* or *Total* is 76, from which

16
76 *Total*
42 being *ſubſtracted*, leaves

34 for the *Remainder*.

Or, you may ſet down the 60 which is borrow'd, and *ſubſtract* 42 the *Number* given,

and to 18 the *Remainder*,
add 16 the *Number* given,

and 34 the *Total*, is the *Remainder* ſought, as before. Then I go on and ſay, 58 *Minutes* from 12 (becauſe 1 was taken before from the 13) I cannot, therefore I borrow 1 Hour, which is 60 *Minutes*; and do as before directed:

60 borrowed;
12 the *Rem.* of the given 13,

72 *Total*
58 *Min.* given to be ſubſtract.

14 *Remainder* ſought.

Or, 60 *Minutes* borrow'd
58 given to be *Subſtracted*.

2 *Remains*.
12 the *Rem.* of the 13 giv.

14 *Total*, is the *Remainder* ſought. Then I go on and ſay, 19 *Hours* from 16, (1 being taken from the 17 before) I cannot, ſo I borrow 1 Day, and do as before, and the *Remainder* is 21; then I go on, and ſay, 218 *Days*, from 106, (1 being taken or borrow'd from the 107) I cannot, ſo I borrow 1 *Year*,

which is 365 *Days*.
To this add 106 the *Remainder* of the 107,

and from the *Total* 471
*Subſtract* 218

and the *Remainder* is 253

Or, ſet down 365 the *Days* borrowed,
and *ſubſtract* 218 the *Days* given,

and to the Remain. 147
add 106 the *Remainder* of 107,

and the *Total* 253 is the *Remainder* ſought. Then I go on and ſay, 1 *Year* out of 1 (1 being taken or borrowed from the 2 before) and there remains 0; then 9 from 1 I cannot, but borrowing 1 from the 7, makes the given 1, 11, and there remains 2; then 6 from 6, (1 being taken from the 7 before) and there remains 0: So that the whole Remainder is 20 *Years*, 253 *Days*, 21 *Hours*, 14 *Minutes*, and 34 *Seconds*; as you may prove either by *Addition* or *Subſtraction*, or both, as you ſee done in all the *Examples* above. After the ſame Manner may any *Weights*, *Meaſures*, &c. be done, regarding only what it is you borrow. And now having fully explained all the poſſible Difficulties of plain or common *Subſtraction*, I now go on to the other Part, called *Diviſion*, or compound *Subſtraction*: In which you are to Note, that as plain *Subſtraction* undoes what plain or common *Addition* does, ſo compound *Subſtraction* or *Diviſion* undoes what *Multiplication* or compound *Addition* has done, or made up.

## DIVISION

Is that *Rule* or Part of *Arithmetick*, whereby you are *Taught* to find how many *Times* one *Number* is *contained* in, or may be *ſubſtracted* from, or out of *another*.

As in *Addition*, you might make a new *Total*, with every particular *Sum*, before you made or found the general *Total*; ſo here you may repeat the ſubſtracting the leſſer given *Number*, or *Numbers*, out of the *greater* given *Number*, till nothing *Remains*, as you will ſee done in the following *Examples*.

*How many Times is* 6 *contained in* 24?

24 Here you may ſet down the 24, which is the great-
6 ter given *Number*, and is called the *Dividend*, or *Num-*
— *ber* to be divided, and ſubſtract from it the leſſer giv-
18 en *Number*, called the *Diviſor*; and again, ſubſtracting
6 the *Diviſor* from the *Remainder*, and ſo continue
— ſubſtracting the leſſer given *Number* or *Diviſor* from
12 the ſeveral *Remainders*, till there either remains 0, or
6 ſome *Number* or *Figure* that is leſs than the *Diviſor*;
— as may be ſeen by the two *Examples* in the Margin.
6
6
—
0

How

*How many Times is* 9 *contained in* 48?

48 In the first *Example*, 24 being set down, and 6 *sub-*
9 *stracted* from it, the *Remainder* is 18; from that
—— take 6, and 12 *remains*; from which take 6, and
39 6 *remains*; from which take 6, and 0 *remains*; so
9 that it appears there are 4 *Times* 6 contained in
—— 24; because there must be made 4 *Substractions* of
30 6, before the *Remainder* is 0. In the second *Exam-*
9 *ple*, 48 being set down, and 5 *Substractions* of 9
—— being made, the *Remainder* is 3, which shews that
21 9 is contained 5 *Times* in 48, and 3 over; and
9 so you may do with any other *Numbers*, bigger or
—— lesser, both in *Whole-Numbers*, and also in *Diverse-*
12 *Denominations*. As,
9
——
3 remains.

*How many Times is* 716 *contained in* 5728?

5728 | 2148 Here, after having *Substracted* 716 continual-
716 | 716 ly from 5728, and its *Remainders*, I find 0
—— | —— *Remains*; from whence I conclude, that 716
5012 | 1432 is contained just 8 *Times* in 5728.
716 | 716
—— | ——
4396 | 716
716 | 716
—— | ——
3680 | 000 *re-* So if it were required to know how many
716 | *mains.* Times *L.* 679 : 17 : 6 ½ was contained in
—— | *L.* 2419 : 18 : 11. By Working after the
2964 | same Manner, the *Answer* would be found to
716 | be 3 *Times*, and *L.* 380 : 5 : 5 ½ *Over*, or
—— | *Remaining*; as you may see by the *Example*
2248 | following. In the same Manner any other
*L.* *s.* *d.* | *Denominations* may be performed, re-
2419 : 18 : 11 | garding only the several *Subdivisions*
679 : 17 : 6 ½ | of the *Sum* given; where you are
———————— | always to observe, that you can ne-
1740 : 01 : 5 ½ | ver *Substract*, *Add*, *Multiply* or *Di-*
679 : 17 : 6 ½ | *vide* different *Names* or *Species*
———————— | from one another, but only those of
1060 : 03 : 11 | the same Name.
679 : 17 : 6 ½
————————
380 : 5 : 5 ½ remains.

But

But what is properly called *Division*, proceeding by different *Steps*, that render the Work more expeditious; for as *Multiplication* performs *Addition* more concisely, though the *Amount* or *Result* is the same; so in like manner *Division*, generally speaking, produces the *Answer* to the *Question*, much sooner and easier than *Substraction*: In this *Rule* or Part of *Substraction*, there are, and have been many different Methods of *Operation* made use of; but the most sure, easy and plain one is this following: First set down the biggest or containing *Number*, then on the *Left-hand* thereof, set down the lesser given *Number*, with this *Partition*, or *Mark* ), between them, and on the *Right-hand* thereof, this *Mark*, or *Partition* ( as you see in the *Example* following.

*How many Times* 5 *are contained in* 35?

*Divisor Dividend Quot.*

5 ) 35 ( 7
35
---
00 remains
---
35

Here I consider what Number multiply'd by 5, will make or come to 35, or to the next less nearest to 35, which by the *Multiplication-Table*, set down, *Page* 16, is found to be 7; for 5 Times 7, or 7 Times 5, is 35; therefore I set the 7, so found, within the *Partition* on the *Right-hand*, and *Multiply* the 5 by it, and set down the *Product* 35, under the given *Number* 35, and *Substract* the one from the other, and the *Remainder* is 00. So if it was ask'd, *How many Times* 5 *are contained in* 44? The *Answer* will be 8 Times, and 4 over; for having set down the Numbers, as before directed, thus, 5) 44 (8 you will find 8 Times 5 makes 40, which being substracted from 44, the *Remainder* is 4. After the same Manner any other *Number* may be *Divided*; and from this small Specimen, you may perceive how much Labour is sav'd by doing it this Way, and by *Common-Substraction*, though the *Answer* will always be the same, let the *Operation* be performed either Way; but if your *Number* to be *Divided*, be very large, in respect of the *Number* that *Divides*, then the Labour would be almost infinite the one Way, over what it would be the other; as, suppose 'twas required to divide 581764, by 8: Here you must make 72720 *Substractions* of 8, before you could give the *Answer*; which how much Time and Paper 'twould take up, I leave you to judge; and shall go on to shew you, how you may come at the

40
---
4 remains.

*Answ-*

*Answer* more easily, and full as surely. *First* set down the given *Numbers*, as in the Margin; which being done, I ask how often 8 is contained in 5, the first *Figure* on the *Left-hand*, which being 0 Times, I do not set down the 0, but I go on and take two *Figures*, *viz.* 58, and the nearest Number of Times that is less, is 7; with this 7 I *Multiply* the *Divisor*, and set down the *Product* 56, and *Substract* it from the 158, and set down the *Remainder* 2, to which I bring down the next *Figure* 1, and it makes 21; then I ask the *Question*, How often is 8 contain'd in 21? and the *Answer* is *twice*, or 2 *Times*, which I set on the *Right-hand* of the 7, and *Multiply* the 8 by the 2, and set down the *Product* 16, under the 21, and *Substract* the one from the other, and the *Remainder* is 5, to which I bring down the next *Figure* 7, and it makes 57; then I enquire how often 8 is contained in 57, and the *Answer* is, 7 *Times*, which I set in the *Quotient* on the *Right-hand* of the former *Figures* 72, before found; then I *Multiply* the 8, by this last 7, and set down the *Product* 56, under the 57, and *Substract*, and the *Remainder* is 1, to which I bring down the next *Figure* 6, and it makes 16; then asking how often 8 is contained in 16, the *Answer* is 2 *Times*, which is set down on the *Right-hand* of 727 before found, and *Multiply* the 8 by this 2, and set down the *Product* 16, under the 16 and *Substract*, and the *Remainder* is 0; to which I bring down the last *Figure*, and it still makes but 4, or 04; and asking how often 8 is contained in 4, the *Answer* is 0 *Times*, which 0 I set in the *Quotient* on the *Right-hand*, and *Multiply* the 8 by 0, and the *Product* is 0, which being *Substracted* from the 4, or 04, the *Remainder* is 4, because 0 on the *Left-hand* of a *Common-Number*, when there are no more *Figures* towards the *Left-hand*, signifies nothing; for which reason the 0 was not set down in the *Quotient* the first Time, when 'twas ask'd, how often 8 was contain'd in the first *Figure* 5; but the 0 must

Divisor Dividend Quot.
8) 581764 (72720
56
21
16
57
56
16
16
04
0
4 remains

o must be put in the *Quotient*, at dividing the laſt *Figure* 4, becauſe the ſeveral *Figures* that were in the *Quotient* before, ſtood on the *Left-hand* of the ſaid o, and were thereby increas'd *Ten-Times* in *Value*; ſo the true *Anſwer* to the *Queſtion* is, that 8 is contained 72720 *Times* in 581764, and 4 over; as may readily be proved, by *Multiplying* the ſaid 72720, by 8, and adding to that *Product* the *Remainder* 4, and the whole *Dividend* 581764, will be again *produced*; or you may *Subſtract* the ſaid *Quotient* 8 *Times* from the *Dividend*; and the ſame *Remainder* 4 will be produced, as you ſee by the following *Example*.

581764
72720
509044
72720
436324
72720
363604
72720
290884
72720
218164
72720
145444
72720
72724
72720
....4

After the ſame Manner may any other Number be performed, as, *How many Times is* 4 *contained in* 71562834?

*Diviſ.* *Dividend* *Quotient.*

4) 71562834 (17890708, Anſwer.

4 4

31 71562832
28 2

35 71562834 Proof.
32

36
36

028
28

034
32

2

*How*

*How many Times is* 5 *contained in* 17156425 ?

5) 17156425 (3431285
15 5
21 17156425 Proof.
20
15
15
06
5
14
10
42
40
25
25
0

*How many Times is* 6 *contained in* 267198467 ?

6) 267198467 (44533077
24 6
27 267198462
24 5 remains.
31 267198467 Proof.
30
19
18
18
18
046
42
47
42
5 Remainder.

*Divif. Divid. Quot.*

9) 5872006 (652445

54..... 9

47 5872005

45 1 Remaindet.

22 5872006 Proof.

18

40

36

40

36

46

45

1 Remains.

Divide 8263475 by 23

23) 8263475 (359281

69..... 23

136 1077843

115 718562.

213 8263463

207 12

64 8263475

46

187

184

35

23

12 Rem.

In this, and all other Caſes, where the *Diviſor* conſiſts of ſeveral *Figures*, you need not ſay how often is 23 contained in 82, but how often is 2 contained in 8, which ſimply is 4 Times; but as you are to carry the *Amount* of the *Tens*, ariſing by the *Multiplication* of the 3, to the *Product* of the 2, 'twill come to too much, or more than that Part of the *Dividend*, with which you are then concerned; for 4 *Times* 23 *amounts* to 92, which is more than 82, therefore it muſt go but 3 *Times*, which is 69; and after the *Subſtraction* is made, the *Remainder* will be 13, to which taking down the 6, 'tis then 136. Now as here are 3 *Figures*, and but 2 in the *Diviſor*, you muſt ſay, how many Times 2 in 13? and allowing for the *Addition* of the 3, 'twill go but 5 *Times*, and the *Product* is

115,

115, and after *Subſtraction* made, the *Remainder* is 21; and the next *Figure* being taken down, this new *Dividend* is 213; and as there is one Figure more here, than in the *Diviſor*, I ſay, how many *Times* 2 in 21? which by reaſon of the 3 being with it, will go but 9 *Times*, and the *Product* is 207, which being *ſubſtracted* from the 213, leaves 6, to which bringing down the 4, it becomes 64; and as here are no more *Figures* in this new *Dividend*, than there are in the *Diviſor*, I take but one *Figure*, and ſay, how oft 2 in 6? and the *Anſwer* will be but 2, becauſe of the 3 being *added* to it, and the *Product* 46 being *ſubſtracted* the *Remainder* is 18, to which bringing down the next *Figure* 7, the *Diviſor* will go 8 *Times*, and the *Product* 184 being *ſubſtracted*, and to the *Remainder* 3 bringing down the laſt *Figure* 5, the *Quotient* will be 1; by which *multiplying* the *Diviſor*, the *Product* is 23, and this being *ſubſtracted* from the 35, the *Remainder* is 12; and now the Work is finiſhed: But to know whether it be truly performed, *multiply* the whole *Quotient*, 359281, by 23, and to the *Product* 7263463 *add* the *Remainder* 12, and the *Total* 7263475 is the ſame with the *Dividend* given; or you may take all the particular *Products*, and the *Remainder*, and *add* them together; and if the Work be true, their *Total* will be the *Dividend*, thus:

Or you may *divide* the given *Dividend* by the *Quotient*, and the new *Quotient* will be the ſame with the former *Diviſor*; and the *Remainder*, if any, will be the ſame as before, as you will ſee by what follows,

| | |
|---|---|
| | 69..... |
| | 115.... |
| | .207... |
| | ...46.. |
| | ...184. |
| | .....23 |
| | .....12 |
| | 8263475 Proof. |

359281) 8263475 (23
718562

1077855
1077643

.....12

Thus you may ſee what a natural Harmony there is between all the Parts of *Arithmetick*; how they depend on, and prove the Truth of one another; for as formerly you were taught to prove *Multiplication* by *Multiplication*, ſo here you ſee *Diviſion* proved by *Diviſion*; for 'tis undeniably certain, that if 23 is contained 359281 *Times*, and 12 over, in 8263475, that 359281 muſt be contained 23 *Times*, and 12 over in the ſame *Number*.

87.....
348.....
..87....
..783...
....348.
.....261
.....48 Remaind.

123456789 Proof.

1419043)123456789(87
11352344.

9933349 Proof.
9933301

.....48 Remain.

Divide 123456789 by 87

87) 123456789 (1419043
87.....

364
348

165
87

786
783

0378
0348

0309
261

048 Remainder.

87
9933301
11352344.
.....48 Rem.

123456789 Proof.

Divide 928765483 by 918

918) 928765483 (1011727
918.....

1076
918

1585
918

6674
6426

2488
1836

6523
6426

097 Remainder.

918.....
..918....
...918...
...6426..
....1836.
.....6426
.....097 Remains.

928765483 Proof.

1011727

1011727) 928765483 (918
9105543..

1821118
1011727

8093913
8093816

.....97 Remainder.

9105543..
.1011727.
..8093816
- - - 97 Remainder.

928765483 Proof.

4072495— | 3215862471628 | 789654
28507465

36511597
32579960

39316371
36652455

26639166
24434970

22041962
20362475

16794878
16289980

504898 Remains.

28507465
32579960
36652455
24434970
20362475
16289980
504898 Rem.

3215862471628 Proof.

789654

789654— | 3215862471628 | 4072495
3158616 | 3158616

5724647
5527578

1970691
1579308

3913836
3158616

7552202
7106886

4453168
3948270

504898 Remains.

5527578
1579308
3158616
7106886
3948270
504898 Rem.

321586247 1628 Proof.

By the ſeveral *Examples*, in *Pages* 88, 90, 91, 92, 93 and 94, you ſee the Truth of the Work proved ſundry Ways, eſpecially by making the *Quotient* a *Diviſor* to the ſame *Dividend*, and you find that which was before the *Diviſor*, then becomes the *Quotient*, and the *Remainder* (where there is one) is always the ſame with the firſt Work: You may likewiſe ſee, that *adding* the *Remainder*, and the ſeveral *Products* of the *Diviſor*, *multiply'd* by the particular *Figures* of the *Quotient*, always produces the *Dividend*, as well as *multiplying* the whole *Quotient* by the whole *Diviſor*, and adding the *Remainder* to that *Total*. And now you have had *Examples* of common *Diviſion* ſufficient to *anſwer* any *Queſtion* that can poſſibly be put in *whole Numbers*: I ſhall only *add* one *Obſervation*, which you muſt carefully obſerve, let your Work be apply'd to what it will, *viz.* That the *Diviſor*, whether it be a ſmall *Number* or a large *one*, muſt be eſteemed ſome *whole Thing broke* or *divided* into ſo many *Parts*, as that *Number* contains *Units*; and if any thing *remains*, that *Remainder* is ſo many of thoſe *Parts*, or ſo many *Parts* of that *whole Thing* or *Unit*, the *Diviſor* repreſents: As for *Example*, in *Page* 86, 44 is *divided* by 5, and 4 *remains*, which 4 is $\frac{4}{5}$ or *four fifth* Parts of a *Thing*; that is, the *Anſwer* to that *Queſtion*, is 8 *whole Times* or *Things*, and $\frac{4}{5}$ or *four fifth* Parts of a *Thing*: So in the next *Queſtion*, Page 87, where 581764 is *divided* by 8, the *Anſwer* is 72720,

and $\frac{4}{8}$ or *four eighth* Parts of a *Time* or *Thing*; ſo again, in Pages 88, 89, and 90, where the *Diviſors* are 4, 5, 6, and 9. In the *Example*, where the *Diviſor* is 4, the *Quotient* or *Anſwer* is 17890708, and $\frac{2}{4}$ or *two fourth* Parts; at 5 the *Remainder* is 0, ſo that the *Anſwer* is abſolutely 3431285 *Times* or *Things* only; at 6 the *Remainder* is 5, ſo that the *Quotient* or *Anſwer* is 44533077 and $\frac{5}{6}$ or *five ſixth* Parts; at 9 the *Remainder* is but 1, ſo that the *Anſwer* or *Quotient* is 652445 and $\frac{1}{9}$ or *one ninth* Part; ſo where the *Diviſor* is 23, the *Remainder* is 12, which is *twelve* twenty three *Parts*; but where the ſame *Dividend* is *divided* by the whole Part of the *Quotient*, and the *Remainder* is the ſame as before, that is 12; but that 12 is not near ſo great in *Value*; for 'tis but 12 Parts of *three Hundred fifty Thouſand, two Hundred eighty one Parts* of ſome *whole Thing* or *Unity*; and ſo in all Caſes whatever, let the *Diviſor* for the Time being, be what it will, it always repreſents *Unity*, divided into ſo many Parts, and is the *Ordinal-Number*, and the *Remainder* is the *Cardinal-Number*, as you may plainly ſee by what is ſaid above. So in the next *Example*, Page 92, where the Diviſor is 87, and the *Remainder* 48, they are called 48 *Eighty-Seventhſ* of ſome whole *Thing* or *Unity*; and when you invert that *Queſtion*, and make the *Quotient* 1419043 the *Diviſor*, the *Remainder* is the ſame in *Figures*, viz. 48, but not the ſame in *Value*; for in this latter *Example*, 'tis but 48 Parts of *one Million four hundred nineteen thouſand and* 43 *Parts of Unity*, which is but about the one *three hundred and thirty thouſandth Part of Unity*; whereas the ſame 48, when 87 was the *Diviſor*, was more than the *one half Part* of *Unity*. In the next *Example*, the *Remainder* is 97, which is 97 - 918 Parts, or 971, 011, 727 Parts, according to what the *Diviſor* is. By what has been already *taught* all *Queſtions* in *whole Numbers* may be truly performed; but as there are ſome *Methods* by which the Work may be ſhortned, or at leaſt eas'd, and which in *Buſineſs* may be very proper to be known, my next Work ſhall be to ſhew you how this may be done. And *firſt*, in all *Caſes* where there are one or more *Cyphers* in the *Diviſor* at the End of, or towards the *Right-hand* of ſignificant *Figures*, it or they may be parted or cut off from the ſignificant *Figures* by a , or | and then cut or part off ſo many *Figures* in the *Dividend*, beginning at the *Right-hand*, or *Unity*, as you ſee done in the following *Examples*, working with the remaining *Figures*, as if the ſaid *Cyphers* did not belong to the *Diviſor*, and as if the 3

*Figures*

*Figures* cut off from the *Dividend* had no relation to it. As, if 5764825 were to be *divided* by 7000; here I cut off the 3 *Cyphers* from the *Diviſor*, and three *Figures* from the *Dividend*; and then it becomes 5764, *divided* by 7, and the *Quotient* is 822, and the *Remainder* is 825 *ſeven thouſand* Parts of *Unity*. So if 1598760007200 was to be *divided* by 890000; here I firſt cut off 4 *Cyphers* from the *Diviſor*, and four *Figures* or *Cyphers*, or both mix'd, as they may happen to be, and then it becomes 15987600 *divided* by 89, tho' the *Figures* will ſtand thus, 89|0000)15987600|7200, and the *Quotient* will be 179635, and the *Remainder* 857200 *Parts* of 890000; for you are always to ſet down the whole given *Diviſor*, and if any thing *remains* in *dividing* by the ſignificant *Figures*, you are to bring down what you cut off from the *Dividend*, and place it on the *Right-hand* of the ſaid *Remainder*, as in the two *Examples* above; in the firſt of which, there *remained* 0, in *dividing* by the 7, therefore the *Remainder* was only the 3 *Figures* that were cut off from the *Dividend*, viz. 825; but in the ſecond *Example* the *Remainder* was 85, and the 4 Figures cut off, were 7200, ſo that the whole *Remainder* was 857200; the like is to be obſerved in all other Caſes of this Kind. But, *ſecondly*, if it ſhall happen that the *Diviſor* ſhould be 1, with one or more *Cyphers*, then the whole Work is done, by only cutting off as many Figures or *Cyphers* from the *Dividend*, as there are *Cyphers* in the *Diviſor*, and the remaining *Figures* of the *Dividend*, towards the *Left-hand*, will be the *Quotient*, and the *Figures* or *Cyphers*, ſo cut off from the *Dividend*, will be the *Remainder*: As, ſuppoſe 527600 was to be divided by 1000, in this Caſe 527 will be the *Quotient*, and 600 the *Remainder*; but ſuppoſe the ſame *Dividend* was to be divided by 10 or 100, in both theſe *Caſes* the *Remainder* would be nothing, that is 0 or 00, and the *Quotient* would be 52760, or 5276; and this, I think, is ſufficient for *Diviſors* that have *Cyphers* on the *Right-hand* of the ſignificant *Figures*. My next Work ſhall be to make the *Operations* both of *ſimple* and *compound* Numbers, ſhorter and eaſier than by the univerſal Method above *taught*; only you are to obſerve that the following *Methods* are not applicable to all *Numbers*; and firſt, when your *Diviſor* is 2, or indeed any even *Number* whatever, you may *halve* your *Dividend* and *Diviſor*; and if by ſo doing, your given *Diviſor* becomes *Unity*, your Work is done, and the ſaid *Half* of the *Dividend* is the *Quotient* ſought: As, if I aſk how often 2 is contained

tained in 578, the *Anſwer* may be found thus, 2|578; ſay, the *Half* of 2, the *Diviſor*, is 1; and the *Half* of 5, the firſt *Figure* of the *Dividend*, is 2, and 1 is left, to which bring down in your *Mind* the 7, and it becomes 17; then ſay, the *Half* of 17 is 8, and 1 is left, to which bring down in your *Mind* the 8, and it makes 18, the *Half* of which is 9; ſo that the whole Work will ſtand thus, $\frac{2}{1}|\frac{578}{289}$ and the *Quotient* is 289; ſo if I was to *divide* 96584 by 2, the *Quotient* would be 48292. If 618 was to be *divided* by 3, the *Quotient* would be 206; for I ſay, how often 3 in 6? and the *Anſwer* is 2, which being ſet down, I ſay, twice 3 is 6, which is equal to, or the ſame with the firſt *Figure* of the *Dividend*, ſo that the *Remainder* is 0; therefore I go on and ſay, how often 3 in 1? and the *Anſwer* is 0; which being ſet down on the *Right-hand* of the 2, I go on and ſay, how often 3 in 18? and the *Anſwer* is 6, which being ſet down, and the 3 *multiply'd* thereby, the *Product* is 18; ſo that the *Remainder* is 0, and the *Quotiont* is 206. So if you *divide* 59278 by 3, the *Quotient* will be 19759, and the *Remainder* will be 1. If 62870 be divided by 4, you may ſay the 4's in 6 is 1, and 2 over; the 4's in 22, is 5, and 2 over; and the 4's in 28, is 7 Times, and 0 over; and the 4's in 7 is 1, and 3 over; and the 4's in 30 is 7 Times, and 2 over; ſo that the *Quotient* is 15717, and the *Remainder* is 2, or 2 *Fourths:* Or you might ſet down your Work as in the Margin, where the *Diviſor* and *Dividend* being ſet down, and firſt *halv'd*, then the *Diviſor* becomes 2, and the *Dividend* 31435; theſe being again *halv'd*, the *Diviſor* becomes 1 and the *Dividend* 15717, and the *Remainder* in this laſt Work is 1, which is equal to the foregoing *Diviſor*, which was 2, this 1 is therefore to be eſteemed 2 *Units* in *Value*; for every *Quotient* is a Repetition of the *Diviſor*, ſo many Times as there are *Units* contained in it: Now 31435 is the *Quotient* of 62870, *divided* by 2, that is, as the original *Dividend* conſiſted of 62870 *Units*, and this latter one conſiſts but of half ſo many 2's, which being divided again by 2 leaves one 2.

| | |
|---|---|
| 4 | 62870 |
| 2 | 31435 |
| 1 | 15717-2 |

Note, *That whenever you break a* Diviſor *into two Parts, for the more eaſy* dividing *any given* Dividend; *if there remains any thing in performing the Work by the firſt* Figure, *they are ſo many* Units; *and if any thing remains in* dividing *by the ſecond* Figure, *they are ſo many* 2's, 3's, 4's, &c. *according to what your laſt* Diviſor *was.*

This being premiſed, I now go on to the other ſingle *Figures*, and require the ſeveral *Quotients* of 7156485, *divided* by 3, 4, 5, 6, 7, 8, 9: Here I will ſhew you how to do them by each ſingle *Figure*, and then how to break ſuch *Figures* as are compounded by the *Multiplication* of two *Figures* together into two *Quotients*.

| *Diviſors* | |
|---|---|
| 3 | 7156485 Dividend. |
| | 2385495 Quotient, and 0 Remains. |
| 4 | 7156485 Dividend. |
| | 1789121 Quotient, and 1 Remains. |
| 5 | 7156485 Dividend. |
| | 1431297 Quotient, and 0 Remains. |
| 6 | 7156485 Dividend. |
| | 1192747 Quotient, and 3 Remains. |
| 7 | 7156485 Dividend. |
| | 1022355 Quotient, and 0 Remains. |
| 8 | 7156485 Dividend. |
| | 894560 Quotient, and 5 Remains. |
| 9 | 7156485 Dividend. |
| | 795165 Quotient, and 0 Remains. |

Here I have choſe to *divide* the ſame *Number* or *Dividend*, by various *Diviſors*, on purpoſe to ſhew you the Difference between a *Smaller* and a *Greater*, and between where there are *Remainders*, and where there are none. As for Inſtance, when I *divide* by 3, the *Quotient* is 2385495, and no *Remainder*; but when I *divide* by 6 the *Quotient* is 1192747, and the *Remainder* is 3; as may be eaſily ſeen by the following Work. Firſt, I ſay, how often 3 in 7? *Twice*, and

and 1 over, ſet down 2, and bring down in your *Mind* the next *Figure* 1, to the *Remainder* 1, and it makes 11; then how often 3 in 11? *Thrice*; ſet down 3, and the *Remainder* is 2; becauſe 3 *Times* 3 is 9, which *taken* out of 11, the *Remainder* muſt be 2; to this 2 bring down in your *Mind* the next *Figure* 5, and aſk, How often 3 in 25? and the *Anſwer* is 8; now 8 *Times* 3 is 24, which *taken* out of 25 leaves 1, which with the next *Figure* 6, makes 16; then the 3's in 16 go 5 *Times*; now 5 *Times* 3 is 15, which being *ſubſtracted* from 16 leaves 1; ſo that the next *Number* to be *divided*, will be 14, in which the 3 is contained 4 *Times*, and the *Remainder* is 2, to which bring down the 8, and it becomes 28, in which 3 is contained 9 *Times*, and 1 is left; then the 5 brought down to that, makes 15, in which 3 is contained juſt 5 *Times*, and nothing *remains*. So that the whole *Quotient*, when all the *Figures* are gone through, is 2385495; but the ſame *Dividend*, when *divided* by 6, has 1192747 for the *Quotient*, and 3 for a *Remainder*, as appears by the following Work: *Firſt*, I ſay, How often is 6 contained in 7? *Once*, and 1 over, to which bring down in your *Mind* the next *Figure*, which is 1, and it makes 11; then how often 6 in 11? *Once*, and 5 over, then the next *Figure* 5, being brought down to this *Remainder*, makes 55, which contains 6 nine *Times*, and 1 over; then the 6's in 16 is *twice*, and 4 over; in 44, ſeven *Times*, and 2 over; in 28, four *Times*, and 4 over; in 45 ſeven *Times*, and 3 over. So that the whole *Quotient* is 1192747, and the *Remainder* is 3. The Truth of this Work, or any other of the like Sort whatever, may be eaſily prov'd by *multiplying* the *Quotient* by the *Diviſor*; and to that *Product* add the *Remainder*, and that *Total* muſt always produce the ſame *Figures* with the *Dividend*.

Or, you may break the *Diviſor* into two ſuch *Parts*, that when *multiply'd* together, the *Product* may be equal to the *Diviſor*; and divide firſt the given *Dividend*, by *one* of thoſe Parts, and that *Quotient* by the other *Part*; as in the laſt *Example* 6, is compos'd of 2, *multiply'd* by 3, or 3 by 2; ſo that according to the firſt *Rule*, 6 being an even *Number*, you may *halve* it, or *divide* it by 2; and that *Quotient* being *divided* by 3, will give the *Anſwer*, as above; or you may *divide* firſt by 3, and then by 2, which you pleaſe.

2 | 7156485
3 | 3578242-1
| 1192747-2

Here, after ſetting down the *Diviſor*, and *dividing* it by 2, the *Quotient* is 3578242, and the *Remainder* 1, which, as was obſerv'd before is 1 *Unit*, or ſimply 1; then *dividing* the *Quotient* 3578242 by 3, that *Quotient* is 1192747, and 1 *Remains:* Now this 1 is to be eſteemed as 2 *Units*, becauſe the former *Diviſor* was 2, which with the 1 that *remain'd* before, makes 3; ſo that this laſt *Quotient* and *Remainder*, is the ſame with the *Quotient* and *Remainder*, when you *divided* by 6 at *once*. So if 9 was the *Diviſor*, I ſay, How often 9 in 71? Becauſe I cannot have 9 in 7, and the *Anſwer* is 7 *Times*, and 8 over; then 9 in 85 is 9 *Times*, and 4 over; in 46 is 5 *Times*, and 1 over; in 14 *once*, and 5 over; in 58 ſix *Times*, and 4 over; in 45, is 5 *Times* and 0 *remains*: Or you might have divided by 3, and 3 and the *Quotient* and *Remainder* will be the ſame, as you may ſee in the Margin, where having *divided* by 3, the *Quotient* is 2385495, and 0 *remains*; which being again *divided* by 3, the *Quotient* is 795165, and 0 *remains*, the ſame as when the *Diviſion* was made by 9, and this will always happen, if your Work is performed right: So that you ſee theſe different *Methods* may ſerve as *Proofs* to one another. I ſhall only recommend the Practice of this Way in ſundry *Examples*, on purpoſe to make you ready and perfect in the Diſpatch of Buſineſs, I would have you alſo practiſe *dividing* by 12 at *once*, in the ſame Manner as you ſee done in the *Example* following, *viz.*

3 | 7156485
3 | 2385495
| 795165

*In* 54768904 *Pence*, *how many Shillings?* Here I begin, and ſay, the 12's in 54 is 4, and 6 over; in 67 is 5, and 7 over; in 76 is 6, and 4 over; in 48 is 4, and 0 over; in 9 is 0; in 90 is 7, and 6 over; in 64 is 5, and 4 over: So that the *Anſwer* is 4564075 *Shillings* and 4 *Pence*. For the Proof of this you may *divide* the given *Number* by 4, and that *Quotient* by 3, or firſt by 3 and then by 4, as you ſee done in the Margin, where firſt dividing by 4, the *Quotient* is 13692226, and 0 *remains*, which in reſpect to the *Numbers* now concern'd, are ſo many 4's; then dividing this *Quotient* by 3, the laſt *Quotient* is 4564075, the ſame with what was

by 4 and 3
4 | 54768904
3 | 13692226
*Proof* 4564075-4

*produc'd*

| by 3 and 4 |
|---|
| 3 \| 54768904 |
| 4 \| 18256301 . 1 |
| \| 4564075 . 4 |

*produc'd* when the *Diviſion* was made by 12 at *once*, and the *Remainder* is 1, which is 4, becauſe the *Diviſion* before was made by 4. In the ſecond *Method* the *Diviſion* is firſt made by 3, and the *Quotient* is 18256301, and 1 *Remains*; this *Quotient* being divided by 4, gives 4564075 for the new *Quotient*, the ſame with the former, and the *Remainder* is 1, which is *once* 3; and the *Unit* that remain'd when the *Diviſion* was made by 3, being added to it, makes the whole *Remainder* 4, as when the *Diviſors* were 4 and 3. Thus you may perform any other *Numbers* whatever, by breaking them into ſuch Parts, as when multiply'd together, will produce the whole *Diviſor* exactly, but not otherwiſe. As, ſuppoſe you was to *divide* by 15, 16, 18, 21, 24, 35, 42, 54, 63, 72, 81, 84, *&c.* for 15, you might take 3 and 5, or 5 and 3; for 16 you may take 4 and 4, or 8 and 2, or 2 and 8, *&c.* as you have been already taught in *Multiplication*; but you are to obſerve, that if you can't find 2, 3, 4, *&c.* Numbers whoſe *Product*, when *multiply'd* together, will exactly produce the whole *Diviſor*, then you muſt uſe the general *Method* before *taught*. As, ſuppoſe you was to *divide* by 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 51, 53, 57, 59, *&c.* no two or more Numbers *multiply'd* together, will exactly bring out theſe *Numbers*, but the *Products* will be either *more* or *leſs*, and therefore you muſt *divide* by the general *Method* firſt *taught*.

*Divide* 792864 by 27.

Here I conſider, and find that 3 *Times* 9, or 9 *Times* 3, make 27; ſo that I work both Ways, and find the *Quotient* to be 2936533, and the *Remainder* 21.

| | | |
|---|---|---|
| 3 \| 79286412 | Or, | 9 \| 79286412 |
| 9 \| 26428804 | | 3 \| . 8809601 . 3 |
| \| 2936533-21 | | \| . 2936533 . 21 |

In the firſt *Method*, having *divided* by 3, the Remainder is 0; then *dividing* that *Quotient* by 9, the laſt *Quotient* is 2936533, and 7 *Remains*; which being 7 *Times* 3, the whole *Remainder* is 21, as you ſee ſet down in the *Example*. In the ſecond *Method*, after dividing by 9, the *Remainder* is

3,

3, and the *Quotient* 8809601, are so many 9's, which being *divided* by 3, the new *Quotient* is 2936533, and the *Remainder* is 2, which being 2 *Nines*, is 18, and 3 that remain'd before, make 21 for the whole *Remainder*, as in the first *Method*; and these two different Ways, or taking the Parts, are Proofs to one another, without any further Process; but you may *divide* by 27 at *once*, according to the general *Method* first *taught*, for your further Satisfaction and Improvement, as is here done.

*Divisor. Dividend. Quotient.*

27 ) 79286412 (2936533
54
252
243
098
081
176
162
144
135
91
81
102
81
21 *Remainder.*

Thus you may go on to any other *Number*, that you can find the exact Parts of, let it be as big as it will; as suppose 'twas ask'd,

*How often* 729 *was contain'd in* 10105109?

Here 9 multiply'd by 9, makes 81, and this by 9 again, makes 729 the exact *Divisor*; there if you divide by 3 *Times* 9, the last *Quotient* will be 13861, and the whole *Remainder*

9 | 10105109
9 | . 1122789-8
9 | .. 124754-35
| ... 13861-440

*mainder* 440; for having *divided* by once *nine*, the *Quotient* is 1122789 *Nines* and 8 *Units*; then *dividing* these 9's by 9, the *Quotient* is 124754 *eighty Ones*, and 3 *remains*, which being 3 *Nines* or 27, this *added* to the firſt 8, makes 35; *dividing* again by 9, the *Quotient* is 13861 *Times* 729, and 5 *remains*, which is 5 *eighty Ones*, or 405, which added to the 35 makes 440 for the whole *Remainder*; ſo that the *Anſwer* to the *Queſtion* is 13861 *Times*, and 440 Parts of 729 over. Again,

*How many Times is* 1728, *contained in* 9158426?

Here I conſider, and find that 12 *multiply'd* by 12, makes 144; and this again by 12, makes 1728; ſo that if I *divide* by 12 three *Times*, the laſt *Quotient* or *Anſwer* will be 5300 *Times*, and 26 the *Remainder*. Here, after the firſt *Diviſion* 2 remains, which is 2 *Units*; after the ſecond Diviſion 2 *remains*, which are 2 *Twelves* or 24; and this added to the firſt 2, makes 26; then *dividing* a third *Time* by 12, the *Remainder* is 0; ſo that the *Anſwer* is 5300 *Times*, and 26 *Parts* over.

12 | 9158426
12 | 763202-2
12 | 63600-26
| 5300-26

*A* RULE *to find the Diviſors.*

If the given *Diviſor* be an even *Number*, you may *halve* it, or *divide* it by 2; and if the *Quotient* that ariſes be alſo an even *Number*, continue *halving*; but when the *Quotient* that ſo ariſes, is an odd *Number*, then try to divide it by ſome ſmall odd *Number* (for it is impoſſible to divide an odd *Number*, by an even *Number* exactly, without leaving a *Remainder*) as, 3, 5, 7, 9, *&c.* and ſo go on till your *Diviſor* is reduced to *Unity*, without leaving any *Remainder* in any of the ſubordinate *Diviſors*; as,

*What are the* Diviſors *to* 336?

Here I *halve* 336, and the *Quotient* is 168; and the *Half* of 168 is 84, the *Half* whereof is 42, and the *Half* of 42 is 21; now this being an odd *Number*, I *divide* it by 3, and the *Quotient* is 7; ſo that the *Diviſors* may be 2, 2, 2, 2, 3 and 7; but as you may think ſo many *Operations* tedious, you may divide your given *Quotient* by 4, 6, 8 or 12; as here, in 336 *divided* by 8, the *Quotient* is 42, this by 6, gives 7; ſo that the *Diviſors* may be 8, 6 and 7. Again,

*What*

*What are the* Diviſors *to* 567?

This being an odd Number, I *divide* it by 3, and the *Quotient* is 189; this by 3, gives 63; this by 3, gives 21; this by 3, gives 7; ſo that the *Diviſors* to this Number 567, may be 3, 3, 3, 3 and 7: Or you may try any other odd *Number* at firſt, as 5, 7, 9; and if any of them ſucceeds and leaves no *Remainder*, that *Number* may be us'd; only *obſerve*, that 5 can exactly *divide* no *Number* whatever, but what ends either with 5 or 0, for which Reaſon I omit trying this *Number* with 5, and try it with 7, and the *Quotient* is 81; and by the common *Multiplication-Table*, I know that 9 *Times* 9 is 81; ſo that 7, 9, 9 may be the *Diviſors*, inſtead of this *Number* 567: After the ſame *Manner* you may try any other *Numbers*. Now follows the *Diviſion* of mix'd Numbers; as,

*If* L.216 : 16 : 8 *be divided among* 8 *Men, How much is that a Piece?*

8 | 216 : 16 : 8
| 27 : 2 : 1

Firſt ſet down the given *Numbers*, both Diviſor and Dividend, as you ſee in the Margin; and then ſay, the 8's in 21 *twice*, and 5 over; in 56, ſeven *Times*, and 0 *remains*; then go on to the *Shillings*, and ſay, the 8's in 16 *twice*, and 0 *remains*; then go to the *Pence*, and ſay, the 8's in 8 *once*, and 0 *remains*; ſo that the *Anſwer* is *L.* 27 : 2 : 1 for each Man.

5 | 65 : 17 : 6
| 13 : 3 : 6

Again, *Divide L.* 65 : 17 : 6 *among* 5 *Men.* Here I ſay, the 5's in 6 *once*, in 15 three *Times*, and all the *Pounds* or whole *Numbers* are done; then I go on and ſay, the 5's in 17 three *Times*, and 2 over; which 2 being 2 *Shillings*, or 24 *Pence*, I add them to the 6, that ſtands in the Place of *Pence*, and the *Total* is 30 *Pence*; then the 5's in 3 is juſt 6, and 0 *remains*; ſo that the *Anſwer* is *L.* 13 : 3 : 6 *per* Man. Again,

*If* 7 *Pieces of Broad-Cloth coſt L.* 197 : 19 : 5, *What's that a Piece?*

7 | 197 : 19 : 5
| 28 : 5 : 7 $\frac{1}{2}\frac{2}{7}$

The *Numbers* being ſet down, I ſay, the 7's in 19 *twice*; in 57 eight *Times*, and 1 *Pound* over, which is 20 *Shillings*; which added to the 19 *Shillings* given, makes 39; then I ſay, the 7 in 39 is five *Times*, and 4 *Shillings* remain which are 48 *Pence*; theſe added to the 5 *Pence*, in the given *Dividend* make 53; then the 7's in 53 is ſeven *Times*,

*Times*, and 4 *Pence* over, which is 16 *Farthings*; the 7's in 16 is twice, and two *Farthings* are left; ſo that the *Anſwer* is *L.* 28 : 5 : 7 : $\frac{1}{2}$ and $\frac{2}{7}$ *Parts* of a *Farthing*; for the *Diviſor*, let it be *little* or *big*, ſhews into how many Parts the Species of *Coin*, *Weight*, *Meaſure*, &c. is divided that was laſt us'd: As in this *Queſtion* we went to *Farthings*, ſo that the *Remainder* is 2 *ſeventh* Parts of a Farthing, for each *Piece*, or 2 whole *Farthings* upon the whole *Quantity*; for if you was to aſk, What will 7 *Pieces* come to at *L.* 28 : 5 : 7$\frac{1}{2}$ a *Piece*? the *Anſwer* would be *L.* 197 : 19 : 4$\frac{1}{2}$; ſo that from hence 'tis plain, that at the given *Price* in our *Queſtion*, a *Piece* muſt be ſomewhat more to make out the whole *Money*. The ſame is to be obſerved in *Weights*, *Meaſures*, &c.

*As*, *in* 2564 *Buſhels of Coals*, *How many Chaldrons?*

3 | 2564
12 | 853-2
| 71-1

Here I conſider that 3 *Buſhels* make a *Sack*, and 12 *Sacks* make a *Chaldron*; therfore I *divide* by 3, and the *Quotient* is 853 *Sacks*, and 2 *Buſhels* over; then I *divide* the Sacks by 12, and the *Quotient* is 71 *Chaldrons*, and 1 *Sack* over; ſo that the *Anſwer* is 71 *Chaldrons*, 1 *Sack* and 2 *Buſhels*.

*In* 564230 *Nails*, *How many Yards?*

4 | 564230
4 | 141057 : 2
| 35264 : 1

Here I conſider, that 4 Nails make 1 *Quarter*; therefore I divide by 4, and the *Quotient* is 141057 *Quarters*, and 2 *Nails* over; then 4 *Quarters* make a *Yard*; therefore I divide the *Quarters* by 4, and the *Quotient* is 35264 *Yards*, and 1 *Quarter* over; ſo that the *Anſwer* to the *Queſtion* is

| *Yards* | *Q.* | *N.* |
|---|---|---|
| 35264 | 1 | 2 |

*In* 5726 *Penny-Weights of Silver*, *How many Pounds?*

20 | 572—6
12 | 286 : 6
| 23 : 10

Twenty *Penny-Weights* being an *Ounce*, I *divide* thereby, and the *Quotient* is 286 *Ounces*, and 6 *Penny-Weights* over; then I *divide* by 12, and the *Quotient* is 23 *Pounds*, and 10 *Ounces* over; ſo that the *Anſwer* is 23 : 10 : 6. And ſo of any other Name whatever.

℔ ℥ *Dwts.*

## CHAP. IV.

### *Of the reduting or changing one* Name *or* Species *of* Money, Weight, Meaſure, *&c. into another, ſtill retaining the ſame* Value.

IN *Schools* 'tis uſual to *teach* a RULE, called

## REDUCTION.

*Reduction* is that *Rule* by which the Number of *Parts*, of one *Name* or *Denomination*, are *turn'd* or *chang'd* into *thoſe* of another, ſtill retaining the ſame *Value*; and it is commonly divided into two Parts, the one called *Aſcending* and the other *Deſcending*. *Aſcending* is when you go upwards, or change a *leſſer* Name into a *greater*. This is done by *dividing* the given *Number*, by ſo many of the *leſſer*, as makes one of the *greater*: As, if you would know how many *Pounds* were contained in 516 *Shillings*; here the Anſwer is produced, by dividing 516, the *Number* of *Shillings* given, by 20, the *Number* of *Shillings* in a *Pound* Sterling: Or, if they were 516 Ounces *Troy-Weight*, to know how many *Pounds*, *Divide* by 12, becauſe 12 *Ounces* make a *Pound*; but if it had been *Avoir-du-poiſe-Weight*, you muſt have divided by 16; and ſo in all other Caſes whatever, regarding carefully the *Number* of *Parts* of the *leſſer*, that make up one of the *greater*. *Deſcending* is when you want to know how many of the leſſer *Name* or *Names*, are contained in 1 or more of the *greater*; in this Caſe, you muſt *multiply* the given *Number* of the greater *Name*, by ſo many of the *leſſer*, as make one of the *greater*: As, if you would know how many *Quarters* of a *Yard* were contained in 516 *Ells* Engliſh: Here you muſt *multiply* by 5, and the *Product* 2580, is the *Anſwer*. So if you would know how many *Pecks* were contained in 812 *Buſhels*, you muſt *multiply* by 4, and the Product 3248 is the *Anſwer*. But if it happens that there ſhould be two or three intermediate *Subdiviſions*, between the given *Name* and *that* required, you may *multiply* thoſe intermediate *Denominations* together, and make their *Product* a *Multiplier* or *Diviſor* to the given *Number*, as the Occaſion requires: Or, you may *multiply* or *divide* continually by the reſpective *Number* of *Parts* of each *Subdiviſion*.

Thus:

Thus: *How many* Farthings *are there in* 54 *Pounds?*
Here are 3 *Subdivisions, viz.* firſt 20 *Shillings* make 1 *Pound*, and therefore I *multiply* the given 54 by 20, and the *Product* 1080 are the *Shillings*, contained in 54 *Pounds*; then 12 *Pence* making 1 *Shilling*, I *multiply* the 1080 *Shillings* by 12, and the *Product* 12960, are the *Pence* in 54 *Pounds*; and as 4 *Farthings* make 1 *Penny*, I *multiply* the 12960 *Pence* by 4, and the *Product* 51840 is the *Farthings* in 54 *Pounds*: Or, you might have *multiply'd* 20, 12 and 4 together continually, and the laſt *Product* 960, would be the *Farthings* in 1 *Pound*; by which *multiplying* the 54, the *Product* would be 51840, the ſame as before; as appears by the Work before you.

| | |
|---|---|
| 20 | |
| 1080 *Shillings.* | |
| 12 | |
| 12960 *Pence.* | |
| 4 | |
| 51840 *Farthings.* | |

54 *Pounds* given.
960 the *Farthings* in 1 *Pound.*

3240
486

51840 the *Farthings* in 54 *Pounds.*

*In* 549 Portugal-pieces *of* Gold, each *L.* 3 : 12 Sterl.
72 *Shill.* in 1 Piece. *How many* Farthings?

1098
3843.

39528 *Shillings* in all.
12 *Pence* in a Shilling.

474336 *Pence* in all.
4 *Farthings* in a Penny.

1897344 *Farthings* in all.

*In* 158 Tons *Avoirdupoiſe Weight, How many Drams?*

20 Hundreds in a Ton.

3160 Hundreds in 158 Tons.
4 Quarters in a Hundred.

12640 Quarters of a Hund. in all.
28 Pounds in a Quarter.

101120
25280

353920 Pounds in all.
16 Ounces in a Pound.

2123520
353920

5662720 Ounces in all.
16 Drams in an Ounce.

33976320
5662720

90603520 Drams in all.

Or,

20
4

80
28

2240
16

13440
2240

35840
16

215040
35840

573440 Dr.
158 in a Ton.

4587520
2867200
573440

90603520 Dr. in all.

By the *Examples* above, you ſee the *Anſwer* is always the ſame, whether you *multiply* the *whole* given *Number* by the firſt *Subdiviſion*, and that *Product* by the next, and ſo on till you come to the *Name* ſought after; or whether you *multiply* thoſe *Subdiviſions* continually together, and that laſt *Product* by the given *Number* of the greater *Name*: But ſometimes it may be done more eaſily and expeditiouſly one Way, than the other, which by *Practice* you will readily find out; and your own Choice or Judgment will dictate to you which *Method* to uſe, as the *Occaſion* may require. Again,

*In* 259 *Miles, How many Inches?*

8 Furlongs in a Mile.

2072 Furlongs in all.
40 Poles in a Furlong.

82880 Poles in all.
11 half Yards in a Pole.

82880
82880

911680 half Yards in all.
18 Inches in a half Yard.

7293440
911680

16410240 Inches in 259 Miles.

*In* 89 Tons *of* Wine, *How many* Pints?

2 Pipes in a Ton.

178 Pipes in all.
2 Hogſheads in a Pipe.

356 Hogſheads in all.
63 Gallons in a Hogſhead.

1068
2136

23428 Gallons in all.
4 Quarts in a Gallon.

93712 Quarts in all.
2 Pints in a Quart.

187424 Pints in 89 Tons.

*In* 567 Chaldrons, *how many* Buſhels?
36 Buſhels in a Chaldron.

3402
1701

20412 Buſhels in all.

*In* 516 common Years, *How many* Minutes?
365 Days in a Year.

2580
3096.
1548..

188340 *Days* in all.
24 Hours in a Day.

753360
376680.

4520160 *Hours* in all the *Days*.
3096 *Hours* over, *viz.* 6 in each *Year*.

4523256 *Hours* in all the *Years*.
60

27139536o Min.

Or, 365 *Days* in a *Year*.
24 Hours in a Day.

1460
730.

8760 Hours in 365 Days.
6 odd *Hours* over in a *Com.* *Year*.

8766 *Hours* in a *Year*.
60 Minutes in an Hour.

525960 *Minutes* in a *Year*.
516 *Years* given.

3155760
525960
2629800

27139536o *Minutes* in 516 *Years*.

Or,

Or, 516 Years.
365 ¼ *Days* in a *Year*.

2589
3096.
1548..
129 for the ¼ of a Day in each *Year*,

188469 *Days* in 516 Years.
24 Hours in a *Day*.

753876
376938

4523256 *Hours* in all, as before.
60 *Minutes* in an *Hour*.

271395360 *Minutes* in all.

REDUCTION ASCENDING.

*In* 4 | 42564820 Farthings, *How many* Pounds?

12 | 10641205 *Pence*.

| 2|0|88676|7 *Shillings* and 1 *Penny*.

*Answer* 44338 *Pounds*, 7 *Shillings* and 1 *Penny*.

Here the given *Number* is *divided* by 4, the *Farthings* in a *Penny*, and the *Quotient* that arises, *viz.* 10641205 is *Pence*; then these *Pence* are *divided* by 12, and the *Quotient* 886767 is *Shillings*, and 1 being left or remaining, is 1 *Penny*; then these *Shillings* being *divided* by 20, the *Quotient* 44338 that arises is *Pounds*, and the *Remainder* is 7 *Shillings*: So the Answer is *L.* 44338 : 7 : 1. Now if we *multiply* 4, 12, and 20 together continually, the last Product will be 960, by which you may divide the given Number, as you have been before taught; and as you see here done.

12 *Pence* in a *Shilling*.
4 *Farthings* in a *Penny*.

48 *Farthings* in a *Shilling*.
20 *Shillings* in a *Pound*.

960 *Farthings* in a *Pound*.

96|0|4256482|0|444338
384

416
384

324
288

368
288

802.
768

340 *Farthings* remains, or 7s. 1d.

Here, after the *Diviſion* is perform'd, the *Quotient* is *L.* 44338 as before, and the *Remainder* is 34, to which bringing down the 0 that was cut off, it makes 340, which are *Farthings*; and therefore I *divide* by 4, and the *Quotient* is 85 *Pence*, which being again *divided* by 12, the *Quotient* is 7 *Shillings*, and 1 *Penny* over: Or, you might have *divided* by 10, 8 and 12, and the Anſwer will be the ſame; as appears by the following Work.

10 | 4256482|0

8 | 4256482 *Two-pence half Penny's.*

12 | 532060 *Twenty-pences*, and 2 *Two-pence Half-penny's*, or 5 *Pence* remains.

44338 *Pounds* and 4 *Twenty-pences*, or 6 *Shillings* and *eight Pence* remains, which with the *five Pence* that *remain'd* before, makes 7 *Shillings* and 1 *Penny*, as before.

*Explanation of the laſt Method.*

The whole *Diviſor* 960, is firſt *divided* by 10, by *cuting* off the firſt *Figure* in the *Units* Place, *viz.* the 0, and then 96 is left; the *Dividend* is alſo *divided* by 10, by *cutting* off the *Figure* in the *Units* Place, which in this *Example* is 0, though it might have been any other *Figure* whatever. Now this 10 is 10 *Farthings*, or *Two-pence Half-penny*, conſequently the *Quotient* 4256482, are *Two-pence Half-penny's*; then I conſider what two *Numbers multiply'd* together, will *produce* 96, and find that 8 and 12 will do it, becauſe 8 Times 12 is 96; then I *divide* by 8, and the *Quotient* is 532060 *Twenty-pences*, becauſe 8 *Times* 2d ½ is 20 *Pence*, and the *Remainder* is 2 *Two-pence Half-penny's*, or 5 *Pence*; then I divide theſe 20 *Pences* by 12, and the *Quotient* is 44338 *Pounds*, becauſe 12 *Twenty-pences* is a *Pound*, and the *Remainder* is 4, which is 4 *Twenty-pences*, or 6 *Shillings* and 8 *Pence*, which added to the 5

Pence that *remain'd* before, makes 7 Shillings and 1 Penny.

If you had divided by 10, 12 and 8, the Work would have ſtood thus:

10 | 4256482|0

12 | 4256482. Two-pence Half-penny's.

| 8|354706 half Crowns and 10 : 2 , rem. or 2s. 1d.

44338 *Pounds* and 2 half *Crowns*, or 5s. remains, which *added* to the 2 s. 1d. makes 7 s. 1d. as before.

*Or, you may do thus:*

8 | 42564820

12 | 5320602 *Two-pences*, and 4 *Farthings* or 1d. *remains.*

| 10|44338|3 *Two Shillings* and 6 *Two-pences* or 1 s. *rem.*

44338 *Pounds* and 3 *two Shillings* or 6 s. *remains*, which added to the two other *Remainders*, viz. 1 s. and 1 d. makes 7 s. and 1d. as before. So you ſee, that uſe what *Method* you pleaſe, if your Work is rightly performed, 'twill always produce the ſame *Anſwer*, proper Care being taken of duly valuing the *Remainders*. Again,

*In* 5864 *Nails*, *How many Ells* Flemiſh?

4 | 5864 *Nails.*

3 | 1466 *Quarters* of a *Yard.*

| 488 *Ells Flemiſh*, and two Quarters over or remaining.

Or,

12 | 5864 *Nails.*

| 488 *Ells Flemiſh*, and eight *Nails*, or two *Quarters* remains.

Here you may firſt *divide* by 4, the *Nails* in a *Quarter*, and that *Quotient* by 3, the *Quarters* in an *Ell Flemiſh*: Or, you may *divide* by 12 at once, which is the *Number* of *Nails* in an *Ell Flemiſh*; and the *Anſwer* both Ways, is 488, *E. F.* and 2 *Quarters* over.

*In* 56425 Penny-Weights *of* Silver, *How many* Pounds?

2|0 | 56425

12 | 2821 *Ounces* and 5 *Penny-Weights.*

| 235 *Pounds*, 1 *Ounce*, and 5 *Penny-Weights.*

*In* 62754 *Grains* of *Gold*, *How many* Ounces?

Here 24 *Grains* making 1 *Penny-Weight*, I break it into 8 and 3.

3 | 62754

8 | 20918 *three Grains.*

2 | 0|2614 *Penny-Weights*, and 18 *Grains.*

| 130 *Ounces* 14 *Penny-Weights*, and 18 *Grains.*

*In* 6258436 *Pints* of *Wine*, *How many* Tons?

8 | 6258436 *Pints.*

7 | 782304 *Gallons* and 4 *Pints*, or 2 *Quarts* remains.

9 | 111757 seven *Gallons*, and five *Gallons* remains.

| 4|12417 *Hogsheads*, and 33 *Gallons*, viz. 4 Sevens now, which is 28; and 5 before, which is 33.

| 3104 *Tons* and 1 *Hogshead*, 35 *Gallons* and 2 *Quarts.*

Page 62, you are told that 2 *Pints* is 1 *Quart*, and 4 *Quarts* 1 *Gallon*, consequently 8 *Pints* is a *Gallon*; therefore I divide first by 8, and the *Quotient* 782304 is *Gallons*, and 4 *Pints* or 2 *Quarts* remains; then 63 *Gallons* being a *Hogshead*, I divide by 7 and 9, because when multiply'd together they produce 63: When I divide by 7, the *Quotient* is 111757 Times 7 *Gallons*, and 5 *Gallons* remains; then I divide this by 9, and the *Quotient* is 12417 *Hogsheads*, and 4 *remains*; which is 4 Times 7 *Gallons* or 28 *Gallons*, and 5 that remain'd before, is 33 *Gallons*. Now 4 *Hogsheads* being 1 *Ton*, I *divide* by 4, and the *Quotient* is 3104 *Tons* and 1 *Hogshead*, which with the former Remainders makes the whole

| | *Tons* | *Hogsh.* | *Gall.* | *Quarts.* |
|---|---|---|---|---|
| *Answer* to be | 4104 | 1 | 33 | 2 |

*In*

*In* 56402650 *Minutes, How many* Days?

6 | 0|5640250

3 | 94004 *Hours* and 10 *Minutes.*

| 8|31334-2

*Anſ.* 3916 *Days* 20 *Hours* and 10 *Minutes.*

Here 60 *Minutes* being an *Hour*, I *divide* thereby, and the the *Quotient* 940004 is *Hours*, and 10 *Minutes* remains, 24 *Hours* being a *Day*, I *divide* by 3 and 8; when I *divide* by 3, the *Remainder* is 2 *Hours*; and when I *divide* by, 8 the *Quotient* is 3916 *Days*, and the *Remainder* is 6, which is 6 *Times* 3, or 18 *Hours*, which added to the other 2, makes 20 Hours; ſo that the *Anſwer* is 3916 *Days*, 20 *Hours* and 10 *Minutes.*

*In* 62584362 *Drams, How many* Tons *Avoirdupoiſe Weight?*

4 | 62584362

4 | 15646090-2

| 4|3911522 *Ounces* and 10 *Drams.*

| 4| 977880-2

| 4| 244470 *Pounds* and two *Ounces.*

7|61117-2

|4|8731 *Quarters* of a *Hundred* and 2 *Pounds.*

2|0|218|2 *Hundreds* and 3 *Quarters.*

*Anſwer* 109 Tons, 2 C. 3 Qr. 2 ℔ 2 ℥ 10 ʒ.

Here 16 *Drams* making an Ounce, I divide by 4 and 4, inſtead of 16; and 16 Ounces being 1 *Pound*, I do the ſame again; and 28 *Pounds* being a Quarter of the long *Hundred*, I divide by 4 and 7; then 4 *Quarters* being 1 C. I divide the *Quarters* by 4; and 20 C. being a *Ton*, I divide the *Hundreds* by 20, and the Anſwer to the Queſtion is as above.

*In* 64287564 Barley-Corns, *How many* Miles?

6 | 64287564

9 | 10714594 two *Inches.*

| 11|1190510 half *Yards*, and 8 *Inches* over.

| 4|0| 10822|8 *Poles*, and 2 half *Yards* over.

|8|2705 *Furlongs*, and 28 *Poles* over.

338 *Miles* and 1 *Furlong* over.

*Miles F. P. ½ Yds. 2 Inch.*

So that the whole Anſwer is 338 : 1 : 28 : 2 : 8

Here I conſider'd that as 3 *Barley-Corns* is 1 *Inch*, ſo 6 is 2 *Inches*; therefore I *divided* by 6, to bring them into 2 *Inches*, and theſe by 9, to bring them into half Yards, becauſe 18 *Inches* is half a *Yard*; and conſequently 9 Times 2 *Inches* is *half* a *Yard*; then by 11, becauſe 11 half *Yards* make a *Pole*, and then by 40, becauſe 40 *Poles* is a *Furlong*, and then by 8, becauſe 8 *Furlongs* is a *Mile*, as may be ſeen in the Table, Page 61. We now ſhall go on to *mix'd Reduction*, viz. where both *Multiplication* and *Diviſion* are us'd in the ſame *Queſtion*. And here 'tis proper to conſult how the leſſer *Names* may be brought into the greater Ones, or the greater *Names* into the leſſer Ones, with the moſt Eaſe and Expedition; for frequently the ſame End may be attain'd by different *Methods*, of which ſome may be much preferable to others.

*In L.* 564 : 15 : 6, *How many* Moidores?
20

3 | 11295 *Shillings.*

9 | 3765 three *Shillings*,

418 *Moidores*, and 3 three *Shillings*, or 9 *Shillings* and 6 *Pence* over or remaining.

Here I firſt *multiply* the *Pounds* by 20, and take in the *odd* 15 *Shillings*, and the *Product* 11295 is *Shillings*, which I divide firſt by 3, and that *Quotient* 3765 by 9, and the *Quotient* 418

is

is *Moidores*, and the three that *remains*, is 3 Times 3 *Shillings*, or 9 *Shillings*; and as there was 6 odd *Pence* in the given Number that will neceſſarily remain, there is a *Method* of *dividing* mix'd *Species* by mix'd *Species*; but as that is ſomewhat difficult, and, as I ſuppoſe my Learner to know no more than what he has been taught in this Book, I will forbear ſaying any Thing upon that Subject at preſent, and content my ſelf with going on in the common Path a while longer.

*In* 1218 Moidores, *How many* Guineas?

3

3654 nine *Shillings*.

9

3 | 32886 *Shillings* in all the *Moidores*.

7 | 10962 three *Shillings*.

1566 *Guineas*.

Here you are to obſerve, that I multiply firſt by 3, and then that *Product* by 9; becauſe as 27 *Shillings* make a *Moidore*, ſo 3 Times 9 is 27. Now, after *multiplying* by 3, that *Product* is ſo many 9 *Shillings*, becauſe 3 Times 9 *Shillings* is a Moidore, or 27 *Shillings*; then I *multiply* 3654 by 9, to bring them into ſingle *Shillings*, which *Product* 32886, I *divide* firſt by 3; and then that *Quotient* 10962, by 7, becauſe 7 Times 3, or 3 Times 7 makes 21, the *Shillings* in a *Guinea*; and the Anſwer is, 1566 *Guineas*, and 0 *remains*. Now, whenever it ſo happens, that you have the ſame *Figure* for a *Multiplier* and a *Diviſor*, you may omit both the *Multiplication* and the *Diviſion*, and the Work will be the ſame, by only operating with the other Figures; as here, in this *Example*, 3 is both a *Multiplier* and a *Diviſor*; therefore I only multiply by 9, and divide by 7, and the Anſwer is exactly the ſame as before, as you ſee in the Margin: For when you have *multiply'd* the given Number of *Moidores* by 9, that Product is 10962 three *Shillings*. Now 7 *Times* three *Shillings* make a *Guinea*, or 21 *Shillings*.

1218 *Moidores*.

9

7 | 10962 three *Shillings*.

| 1566 *Guineas*.

And

And ſo you may work in all other *Queſtions* whatever, let the *Name* or *Denomination* be what it will.

*In* 2159 Pieces *of* 36 Shillings *each*, *How many* Guineas?

12

7 | 25908

3701 *Guineas*, and 3 *Shillings* remains.

Here I conſider that 3 *Times* 12 is 36, and 3 *Times* 7 is 21; therefore I *multiply* by 12, and *divide* that *Product* by 7, ommiting the 3 both in *multiplying* and *dividing*, for the Reaſons above.

*In* 1566 Guineas, *How many* Moidores?

7

9 | 10962 three *Shillings*.

1218 *Moidores*.

*In* 156 Packs *of* Cloth, *each* 47 Pieces, *each* Piece 27 E. Eng. *How many* Yards?

47 *Pieces* in a *Pack*.

1092
624.

7332 *Pieces* in all.
27 Ells *Engliſh*, in a *Piece*.

51324
14664.

197964 Ells *Eng.* in all.
5 *Quarters* in an Ell *Engliſh*.

4 | 989820 *Quarters* in all.

| 247455 *Yards* in all.

*In*

*In* 5628 *Hogſheads, How many* Puncheons *of* 84 Gallons *each?*

9

12 | 50652 ſeven *Gallons.*

4221 *Puncheons.*

Here I conſider, that a *Hogſhead* is 63 *Gallons*; and that 7 Times 9, or 9 Times 7, is 63; and that a *Puncheon* is 84 *Gallons*, or 7 *Times* 12, or 12 *Times* 7; ſo that I omit the 7, and *multiply* by 9, and *divide* by 12, and the *Quotient* 4221, is the Anſwer ſought, as may be ſeen by the Work at large.

5628
63
16884
33768
84)354564(4221
336
185
168
176
168
84
84
00 remains.

You muſt always obſerve, that your *Dividend* and *Diviſor* is, or muſt be reduced to the ſame *Name*, otherwiſe you can't perform the Work: So in the laſt *Example*, when you *multiply'd* by 9, the *Product* was 50652 ſeven *Gallons*; becauſe the given *Number* being *Hogſheads*, each *Hogſhead* contains 63 *Gallons*, or 9 Times 7 *Gallons*, and the *Diviſor* 12, is a ſeventh *Part* of a *Puncheon*, or 84 *Gallons*. You may alſo obſerve, that when the *Multiplier* and *Diviſor* can both be *divided* by ſome common *Number*, without leaving any *Remainder*, you may *multiply* and *divide* by thoſe *Quotients*, and the *Anſwer* will be the ſame as before: As in the laſt *Example*, the *Multiplier* is 9, and the *Diviſor*

12, both which may be *divided* by 3, and the *Quotients* will be 3 and 4; with which, working as before, the *Anſwer* will come out the ſame, as follows.

*In* 5628 Hogſheads, *How many* Puncheons?

3

4 | 16884

4221 *Puncheons.*

The like is to be underſtood in all other Caſes, where Contractions may be made; otherwiſe you muſt work with full Numbers, as you ſee this laſt *Example* done; and if any Thing *remains*, it is ſo many of the leſſer Parts, as makes one of the greater. Enough has been ſaid upon this Head, ſo that I will now go on to the *Doctrine* of *Proportion*, commonly called the *Rule* of *Three*.

## CHAP. V.

### *Of the* Rule *of* Proportion, *commonly called the* Rule *of* Three, *and by way of Eminence the* Golden-Rule.

ALL the compound Parts of *Arithmetick*, are in reality but this *Rule*, under different *Names*; for at leaſt three Numbers are always given to find a Fourth, even in plain *Multiplication* and *Diviſion*, as will appear by conſidering what follows; for there *Unity* is always ſuppos'd, tho' not expreſs'd, and the *Product* or *Dividend* contains the *Multiplier* or *Diviſor*, as often as there are Units in the *Multiplicand* or *Quotient*; as if I ſay, *multiply* 57 by 98: Here I *virtually* tho' not *actually* ſay, as often as 1, or *Unity* is contained in 98, the *Multiplier*, ſo often 57 the *Multiplicand* is contained in 5586, the *Product*; or more conciſely, as 1 is to 98; ſo 57 to 5586. Or if I ſay, *divide* 5586 by 57, 'tis the ſame Thing, as ſaying, as 57 is to 1; ſo is 5586 to 98. Now to effect this, or to find out the *fourth proportional* Number

or

or Quotients *ſought*, you are to obſerve, always to put the *Number* or *Quantity* that aſks the *Queſtion*, What? *How many?* &c. in the third *Place*, or that next towards the *Right-hand*, and that *Number* or *Quantity* that is of the ſame *Nature*, *Name*, or *Kind* with the *demanding Number*, firſt towards the *Left-hand*, and the other *Number* or *Quantity*, concerned in the *Queſtion*, in the *Middle*: Having thus diſpos'd of the *Numbers*, *multiply* the two that ſtood toward the *Right-hand* together, and *divide* their *Product* by the firſt *Number*: As you ſee done in the following *Examples*.

*If* 1 *Yard of Cloth coſt* 6 *Pence*, *What coſt* 8 *Yards?*

Here, the Numbers being diſpoſed, as was juſt now directed, they will ſtand thus: 1--6--8 then *multiplying* the 6 ſecond and third together, the *Product* is 48; but the firſt *Number* being *Unity*, or 1, neither *multiplies* nor *divides*; therefore the *Product* 48, is alſo the *Quotient*. Now you are to obſerve, that when the given Numbers are diſpos'd according to the foregoing *Rule*, whatever *Name* the ſecond *Number* bears at the Time of *multiplying*, the *Quotient* alſo bears, after the *Diviſion* is perform'd. So here if you *divide* the *Product* 48, by 1, the *Quotient* will be the ſame, *viz.* 48; ſo that it is 48 *Pence*, becauſe the 6 or middle *Number* was *Pence*, which may be brought into *Shillings* by *dividing* by 12. Again,

*If a* Sack *of* Malt, *Quantity* 4 Buſhels, *coſt* 12 s. 6d. *What comes* 85 Buſhels *to, at the ſame Price?*

Here the *Enquiry* is, to know how much 85 *Buſhels* coſt; and therefore that *Number* is to be put in the third or laſt *Place*, and the Number that is of the ſame *Name*, *Kind*, or *Quality* with it, muſt be the firſt *Number*; and the other *Number*, or *Price* of the firſt *Quantity*, will be the ſecond or middle *Number*.

Thus, *Buſh.* *s.* *d.* *Buſh.*

4 —— 12 6 —— 85

12

150

85

750

1200

4 | 12750

12|3187-2

20|26|5-7

*L.* 13|5-7

Now foraſmuch as the 2d *Number* is a mix'd *Number* of *Shillings* and *Pence*, 'twill be proper to bring it all into *Pence*; which being done, is 150; that *multiply'd* by 58, makes 12750, which *divided* by 4, the firſt *Number*, the *Quotient* 3187 is *Pence*; becauſe the ſecond *Number* was brought or reduced into *Pence*, and 2 *remains*.

In *Page* 94, you were told that the *Diviſor*, let it be ſmall or great, always repreſents ſome whole *Thing* or *Unity*, ſuppoſed to be *broke* or *divided* into ſo many *equal Parts*, as the *Diviſor* contains *Units*: Now in all Caſes where Names are put to the working *Numbers*, this *Diviſor* always repreſents one whole *Thing*, or *Unity* of the ſame Name, ſo *divided* as the firſt *Quotient* denominates. Now here, in this *Example*, this *Quotient* is *Pence*, and therefore a *Penny* is here *divided* into 4 *Parts*, becauſe the *Diviſor* happens to be 4; and conſequently the *Remainder* 2, is 2 *Farthings*, becauſe a *Farthing* is the fourth *Part* of a *Penny*. But as this Caſe may be frequently varied, and both the Name of the Unit, and the Parts, may be alſo infinitely differenced, therefore obſerve this general *Rule* following, for finding the Value of ſuch *Remainders*.

*Set down the Number remaining, after the firſt* Diviſion, *which on this* Example *is* 2; *then conſider what it is* 2 *Parts of*; *and in this* Example *'tis* 2 *Parts of a* Penny; *then conſider what is the next inferior* Denomination, *which in this* Example *is* Farthings; *multiply the ſaid* Remainder *by the Number of Parts in the next inferior* Name, *which here is* 4, *becauſe* 4 Farthings *make a* Penny; *and* divide *that* Product *by the* Diviſor, *which in this* Example *is* 4, *and the* Quotient *is the* Value *of the ſaid* Remainder, *in that next inferior* Denomination, *which here is* 2, *and* 0 *remains: But if there ſhould*

*ſhould be a ſecond* Remainder, *you may continue the ſame* Proceſs, *till you come to the loweſt known* Subdiviſion, *in that Part of* Money, Weight, Meaſure, *&c. you are then concerned about*; *and after you have gone to the loweſt known* Subdiviſion, *commonly us'd*; *and after dividing ſtill by the ſame Diviſor, there ſhould be yet a* Remainder, *that laſt* Remainder *will be ſo many Parts of the laſt* Subdiviſion *you* multiply'd *by*. The foregoing *Queſtion* may be wrought as follows, *viz.*

*If* 1 Sack *or* 4 Buſhels coſt 12s. 6d. *What's the Value of* 85 Buſh.

2 *Sixpences* in 1 *Shilling*.

| | |
|---|---|
| 1 | 25 *Sixpences* in 12 : 6. |
| 6 | 85 the third *Number*. |
| 4 \| 6 \| 1 | 125 |
| 4 | 200. |
| 2 | 4 \| 2125 (1 remains, which is $\frac{1}{4}$ of 6 *Pen.* |
| 4 | |
| 4 \| 8 | 4 \| 0\|53\|1 Sixpences. |
| 2 | 13-5-6 |
| | 1 $\frac{1}{2}$ in the *Remainder*. |
| | *L.* 13-5-7 $\frac{1}{2}$ Anſwer, as before. |

Here I only bring the middle *Number* into *Sixpences*, by *multiplying* the *Shillings* by 2, becauſe 2 *Sixpences* are 1 *Shilling*, and I take in the odd *Sixpence*; ſo that there are 25 *Sixpences* in 12 s. and 6 d. then I *multiply* by 85, and *divide* by 4, and the *Quotient* is 531 *Sixpences*, and 1 remains, which 1 I multiply by 6, and divide that *Product* by 4, the former *Diviſor*, and the Quotient is 1 *Penny*, and 2 remains, which 2 I multiply by 4 the *Farthings* in a *Penny*, and divide the Product 8 by the former *Diviſor*, and the *Quotient* is 2 *Farthings* and 0 *remains*; ſo that the Value of this 1 that remain'd after the firſt *Diviſion* is 1 *Penny* and 2 *Farthings*, as will evidently appear by what was ſaid above, and at *Page* 94; for that 1 was the *one fourth Part* of Sixpence, which is three *Half-pence*: The 531 *Sixpences* I divide by 40, becauſe 40 *Sixpences* are 1 *Pound*, and the *Quotient* is 13 *Pounds*, and 11 remains, which are 11 *Sixpences*, or 5 s. and 6 d. to which add 1 d. $\frac{1}{2}$ the *Value* of the *Remainder*, and the Anſwer is *L.* 13 : 5 : 7 $\frac{1}{2}$, as before.

Again, Suppoſe I ſhould ſay, *If L.* 13 : 5 : 7 ½ *buy* 85 *Buſhels of Malt, What muſt I pay for* 1 *Sack of* 4 *Buſhels?*

Here, by obſerving the *Queſtion*, as 'tis now put, I find that the *Sack*, or 4 *Buſhels* is the aſking Number; and therefore muſt be put in the third Place; and then, according to the former Directions, the whole will ſtand thus;

*Buſh.* *L.* *s.* *d.* *Buſh.*
85 — 13 : 5 : 7 ½ — 4
20

265
12

3187
4

12750 *Farthings.*
4 third Number.

85 | 51000 | 4 | 600
510

12 | 150
...00

12 : 6

Here the middle *Number* being a mix'd Number, conſiſting of *Pounds*, *Shillings*, *Pence*, and *Farthings*, 'tis brought into the loweſt *Name*, viz. *Farthings*; and then thoſe *Farthings* are multiply'd by the third *Number*, and that *Product divided* by the firſt Number, and the *Quotient* 600 is *Farthings*; becauſe the middle *Number* was reduced into *Farthings*, which being *divided* by 4 and 12, produces 12 s. and 6d. as before. So that by varying the *Queſtion* in this Manner, the different Works will be Proofs to one another, if the Work be performed truly, and according to the foregoing Directions. I have been very full in explaining every *Punctillio* neceſſary to be obſerv'd; and therefore hope the Reader, by carefully obſerving what has been ſaid, will be able to anſwer any other *Queſtions* in this *Rule*, without further Help, though, as Occaſion offers, I ſhall explain what may occur hereafter, that carries any Face of Difficulty at the Time of its ſo happening.

*Suppoſe*

*Suppoſe I buy a Bale of Linen Cloth, Quantity* 58 *Pieces, each Piece* 29 *Ells* Engliſh, *at* 15 *d.* ½ *per Yard, What is the whole Worth, and how much do I gain* per Cent. *if I ſell it at* 21*d. per Ell* Engliſh?

Here are ſeveral *Queſtions* or *Demands* in this one, and therefore I conſider *firſt*, what is *given*, and then what is *ſought*, viz. the *Price* of a *Yard* is *given*, and the *Price* of a *Bale* is *ſought*; therefore I ſay,

*If* 1 Yard *coſt* 15 *d.* ½, *What coſt* 1 Bale *or* 58 *Pieces each Piece* 29 *E.* Eng.

4 4

4 *Quarters* 62 *Farthings*

522
116
1682 *E.* Eng. in all.
5
8410 *Quarters.*
62
16820
50460.

*d. d.*
4 | 521420 *Pro. of* 2,3
4 | 130355 *Farthings*
*q.*
12 | 32588 *d.* & 3 ov.
2|0|27 1|5 *Shil.* 8*d.*
135 *L.* 15*s.* 8¼.

## EXPLANATION.

After ſtating or ſetting down the *Numbers*, as above, I *multiply* the *Pieces* by 29, the Ells *Engliſh* in a *Piece*, and the *Product* 1682 are the Ells *Engliſh* in all; but as the firſt *Number* is a *Yard*, I muſt reduce both the *Yard* and the *Bale* into *Quarters*, to make them both of one *Name*, viz. *Quarters*; then, becauſe the middle or ſecond *Number* is *Pence* and *Farthings*, I reduce it into *Farthings*, and then *multiply* the 3d *Number* or *Bale*, reduced into *Quarters* by it, *viz.* 62,

62; and that *Product* 521420, I divide by the first *Number* or *Yard*, reduced into *Quarters*, viz. 4, and the *Quotient* 130355 is the *Answer*, in the *Name* the second *Number* was *reduced* into, viz. *Farthings*, which are *reduced* first into *Pence*, then into *Shillings*, and then into *Pounds*; and the compleat *Answer* to the first *Query*, viz. the whole *Cost* of the *Bale* is *L.* 135 : 15 : 8¼.

The next Thing to be enquired after, is the whole *Money* it was *sold* for; to find out which, the Price of 1 *Ell* is given to find the Value of the *Bale*; therefore, I say,

*If* 1 Ell *is sold for* 21 *Pence, What is the Value of* 1682 Ells?

21

1682

3364.

12 | 35322

2 | 0|294|3-6

*Answer* *L.* 147 : 3 : 6

By this Process, I find that the *Bale*, when *sold* at 21 *Pence* per *Ell*, will amount to *L.* 143 : 3: 6. Now the third *Query* is, What is my Gain per *Cent.* or for laying out one hundred *Pounds*? To find which, I say, If the *Money* the *Bale* cost, yield or give the *Money* it is sold for, *What will L.* 100 *yield or give*? Thus,

If *L.* 135 : 15 : 8¼ give *L.* 143 : 3 : 6, what will *L.* 100 give.

| | | |
|---|---|---|
| 20 | 40 | 20 |
| 2715 *Shill.* | 5727 *Sixpences,* | 2000 |
| 12 | 96000 | 12 |
| 32588 *Pence.* | 34362000 | 24000 |
| 4 | 51543 | 4 |
| 130355 *Farthings.* | 549792000 | 96000 |
| | | 130355 |

130355) 549792000 (4 | 0 (421 | 7 *Sixpences.*

521420

105 : 8 : 6

283720 — 3 ¾ *Quot.* arising

260710 — *L.* 105 : 8 : 9 ¼ from the *Remainder.*

230100

130355

997450

912485

84965 Remainder which are Parts

6 of a *Sixpence.*

509790

391065

118725 — *N.B.* The *Quotient* 3d. ¼ is set above to be added to the *L.* 105 : 8 : 6.

4

474890

391065

83825

Here the first *Number* being compounded of *L. s. d.* and *Farthings*, 'tis brought into *Farthings*, which occasions the third *Number*, viz. the *L.* 100 to be brought into *Farthings* also, to be of the same *Name* with it, although that be not compounded; the second *Number* is only brought or reduced into *Sixpences*, by multiplying the *Pounds* by 40, the *Sixpences* in a *Pound*, and taking in 7, the *Sixpences* in 3 s. and 6 d. so that after *multiplying* the second and third *Numbers* together so reduced, and *dividing* by the first, the *Quotient* 4217, which is the *Answer* to the *Question*, is *Sixpences*, which are brought into *Pounds*, by *dividing* by 40, and the *Remainder* 84965, is so many Parts of 130355 of *Sixpence*, for which Reason the *Remainder* is *multiply'd* by 6, and that *Product* 509790 is *divided* by the former *Divisor*, and the *Quotient* 3, is *Pence*, and the *Remainder* is Parts of a *Penny*, which is *multiply'd* by 4, and that *Product divided* again by the former *Divisor*, the *Quotient* 3 is *Farthings*,

*things*, and the *Remainder* is Parts of a *Farthing*; ſo that the *Anſwer* is *L.* 5 : 8 : 9 ¾ and

$$\frac{83825}{130355}$$ Parts of a *Farthing* gain'd *per Cent.*

For the *Stating* is, If the whole *Sum* laid out, *produce* the whole *Sum* ſold for; which, as it comes to more, ſhews the whole *Gains* to be ſo much as is the *Difference* (which in this *Example* is *L.* 7 : 7 : 9, and $\frac{46530}{130355}$ Parts of a *Farthing.*)

So is the third *Number*, or *L.* 100 to 105 : 8 : 9 ¾ and $\frac{83825}{130355}$ Parts of a *Farthing*:

The Difference between which, being *L.* 5 : 8 : 9 ¾, *&c.* is the *Gain* per *Cent.*

*If I lay out L.* 560 *in* Wheat, Malt, *or other* Corn, *when 'tis ſold for* 4 *s.* 3 *d. per* Buſhel; *and ſell the ſame again for* 38 Shillings *per* Quarter, *What do I gain per* Cent?

Here the whole *Quantity* Bought, at 4 s. 3 d. per *Buſhel*, is Sold at *L.* 1 : 18 per *Quarter*; therefore the firſt *Query* will be, to find the Coſt of a *Quarter* at 4 s. 3 d. per *Buſhel*. Now as 8 *Buſhels* make a *Quarter*, I *multiply* the Price of a *Buſhel* by 8, and the *Product* 34 *Shillings* is the Coſt of a *Quarter* at that *Rate*; by which it appears that 4 *Shillings* is gain'd by every *Quarter* Bought; therefore I ſay, If 34 *Shillings* gain 4 *Shillings*, *What will L.* 100 *gain?*

| | |
|---|---|
| 4 : 3 | |
| 8 | |
| 34 | |
| 20 | |
| 2000 | |
| 4 | |
| 8000 | |

After bringing the third *Number L.* 100 into *Shillings*, which makes it of the ſame *Name* with the firſt *Number*, viz. *Shillings*, I *multiply* the ſecond and third *Numbers* together, and *divide* their *Product* 8000 by the *firſt* Number; and the *Quotient*, which is the *Anſwer* to the *Queſtion*, is 235 *Shillings*; be-

cauſe

cauſe the ſecond or middle *Number* was *Shillings*, and the *Remainder* 10, is *Ten* 34 *Parts* of a *Shilling*; for which Reaſon I *multiply* the 10 by 12, the *Pence* in a *Shilling*, and *divide* the *Product* 120 by 34, and the *Quotient* 3 is *Pence*, and the *Remainder* 18, is 18 *thirty four Parts* of a *Penny*, which I *multiply* by 4, the *Farthings* in a *Penny*, and *divide* the *Product* 72, by 34, and the *Quotient* 2, is *Farthings*, and the *Remainder* 4, is *four* 34 *Parts* of a *Farthing*; ſo that the true *Anſwer* to the *Queſtion*, that wants to know the Gain *per* Cent. is *L.* 11 : 15 : 3 : 2, and $\frac{4}{34}$ Parts of a *Farthing*.

Now to know what is gain'd by laying out the whole *Sum* *L.* 560, I ſay,

34 | 8000 | 2|0|2|3|5
68
*L.* 11 : 15
120
102
180
170
10 *Parts* of a *Shil.*
12
34) 120 (3 *Pence.*
102
18 *Parts* of a *Pen.*
4
72 (2 *Farthings.*
68
4 *Parts* of a *Far.*

If 34 s. gain 4 s. *What will L.* 560 gain?

20
11200
4
44800

Or

Or thus,

Here, after *dividing* by the first *Number* 34, the *Remainder* is 22 *Parts* of a *Shilling*, which being wrought as before, comes to 7 *Pence* 3 *Farthings*, and 2 Parts of a *Farthing* remains; so that the true Answer to this *Question* is *L.* 65 : 17 : 7 : 3 & $\frac{2}{34}$ Parts of a *Farthing* gain'd by laying out *L.* 560 in this Manner.

34) 44800 (2 | 0 | 1317

34

108

102

60

34

260

238

22 *Parts* of a *Shilling*.

12

264 (7 *Pence*.

238

26 *Parts* of a *Penny*.

4

104 (3 *Farthings*.

102

2 *Parts* of a *Farthing*.

*L.* 65 : 17 : 7 : 3 & $\frac{2}{34}$ *Parts* of a *Far.*

I might now go on to more curious and difficult *Questions*, and also to the Method of *Practice*, or working by *Contractions*, and breaking the given Price into Parts, *&c.* but as all these Matters entirely depend upon understanding the *Doctrine* of *Fractions*, my next Business shall be to teach you what a *Fraction* is; their diverse *Sorts*, and the best and shortest *Methods* of using them; by applying them to a great Variety of Cases, in all the Parts of *Mercantile Affairs* in particular; the like of which has not (as I know of) been so fully and plainly done by any Body else.

CHAP.

# CHAP. VI.

## *Of* Fractions, *their* Definition, *various* Sorts, *and Manner of uſing them.*

A *Fraction* is a Part of *Unity* or ſome whole *Thing*, whether it be *Money*, *Weight*, *Meaſure*, *Time*, &c. There are two Sorts of *Fractions*, the one called *Vulgar* (or *Natural*) *Fractions*, the other *Decimal* or *Artificial-Fractions*; and as the *Vulgar* or *Natural-Fractions*, are the firſt in order, I ſhall firſt handle them, and then ſhew the Agreement between the two Sorts; and in the Application, endeavour to give you Hints to aſſiſt you, when to uſe the one Sort, and when the other; becauſe each have their peculiar Excellence; and in particular Caſes, the one may be much eaſier and more expeditious than the other.

### *Of* Vulgar *or* Natural-Fractions.

A *Vulgar* or *Natural-Fraction*, is that which exactly expreſſes the *Quantity* of the Part or Parts of any whole *Thing*, whether it be actually or imaginarily ſubdivided into any Number of Parts whatever. Every *Vulgar-Fraction* is expreſſed by two *Numbers*, ſet over one another, with a Line drawn between them, thus $\frac{2}{3}$, or $\frac{1}{8}$, or $\frac{245}{1823}$, the lowermoſt whereof expreſſes the *Number* of *Parts*, the *whole Thing* is *really* or *imaginarily* divided into, and is therefore called the *Denominator*; and this is the ſame with the *Diviſor* in *Diviſion*, let it be a ſmall *Number* or a large one. The uppermoſt *Number* is called the *Numerator*, from its numbering or ſhewing how many Parts of the whole *Thing* is expreſſed by the *Fraction* then in uſe; as $\frac{5}{9}$ Numerator, Denominator, and is the ſame with the *Remainder* in *Diviſion*, where there happens to be one, as was hinted in Page 94; for here the whole *Thing* is ſuppos'd to be *divided* into 9 *Parts*, and the *Number* expreſſes 5 of thoſe 9 *Parts*.

Of *Vulgar Fractions* there are three Sorts, *viz.*

*A proper, ſimple, or pure Fraction.*
*An improper Fraction,*
*And a compound Fraction.*

A *proper*, *ſimple*, or *pure Fraction* is expreſſed by one *Numerator* and one *Denominator*, and is always leſs than *Unity*, becauſe the *Numerator* is always leſs than the *Denominator*, as $\frac{1}{7}$, or $\frac{3}{7}$, or $\frac{6}{7}$, or $\frac{7}{8}\frac{1}{9}\frac{2}{8}$, or $\frac{4}{6}\frac{3}{6}$, &c. An *improper Fraction* is likewiſe expreſſed by one *Numerator* and one *Denominator*, and is greater, or at leaſt equal to *Unity*, having the *Numerator*, always either greater or equal to the *Denominator*; and is the ſame with the *Dividend* in *Diviſion*, as $\frac{12}{7}$, or $\frac{16}{4}$, or $\frac{18}{18}$, &c.

A *compound Fraction* is always expreſſed by, at leaſt, two *Numerators* and two *Denominators*; and ſometimes by 3, 4, 5, or more, with the Word OF between each *Numerator* and *Denominator*, which may conſiſt of the ſame Figures, or different ones, as,

$\frac{1}{4}$ of $\frac{1}{4}$, OR $\frac{1}{3}$ of $\frac{5}{7}$ of $\frac{6}{9}$, OR $\frac{2}{3}$ of $\frac{1}{2}$ of $\frac{5}{3}$, &c.

Having now defin'd the ſeveral Sorts of *Vulgar Fractions*, before you can *add* or *ſubſtract* them, you muſt learn the *Reduction* of *Fractions*, which teaches you to bring *compound Fractions* into ſingle ones; *Fractions* expreſſed by large *Numbers*, into thoſe expreſſed by ſmaller ones, and *Fractions* of various *Denominators* into thoſe expreſſed by one common *Denominator*: Of which in their Order; and firſt,

### *To reduce a* compound Fraction *to a* ſingle one.

Becauſe in all Caſes whatever, before any Work can be regularly done in Fractions, if a compound Fraction is concerned, it muſt be reduced to a ſingle Fraction, by bringing it into a proper, or an improper one; which is done thus:

*Multiply all the Numerators together, for a new Numerator, and all the Denominators together, for a new Denominator; and this new Fraction thus produced, ſhall be equal to the compound Fraction given*, and will ſometimes turn out a *ſimple Fraction*, and ſometimes an *improper Fraction*; as in the *Examples* above, where the $\frac{1}{4}$ of $\frac{1}{4}$ produces $\frac{1}{16}$, and the $\frac{3}{7}$ of $\frac{5}{7}$ of $\frac{6}{9}$ gives $\frac{90}{315}$; and the $\frac{2}{3}$ of $\frac{1}{2}$ of $\frac{5}{3}$ gives $\frac{10}{18}$; for in the firſt *Example*, *multiplying* 1 by 1, the *Product* is 1 for the new *Numerator*; and 4 by 4, the *Product* is 16 for the new *Denominator*; ſo that $\frac{1}{4}$ *of* $\frac{1}{4}$ *is* $\frac{1}{16}$. In the ſecond *Example*, *multiply* the *Numerators* 3, 5 and 6 together continually, and the *Product* is 90, for the new *Numerator*; then *multiplying* 5, 7 and 9 together continually, and the *Product* is 315 for the new,

new *Denominator*; ſo that $\frac{1}{4}$ *of* $\frac{2}{7}$ *of* $\frac{4}{5}$ become $\frac{8}{140}$. And in the third *Example*, 8, 1 and 5, multiply'd continually together, gives 40 for a new *Numerator*, and 2, 2, and 3, gives 12 for a new *Denominator*; ſo that the new *Fraction* is $\frac{40}{120}$ inſtead of $\frac{4}{8}$ of $\frac{1}{2}$ of $\frac{1}{5}$. Tho' the *Operations* in the *Fractions* given will always give the true *Anſwers* to the *Queſtions*, about which they are concern'd; yet very often the Work may be ſhortned, by reducing the given *Fractions* into others of the ſame *Value*, tho' *expreſs'd* by *ſmaller Numbers*, or *lower Terms*; and therefore the next *Rule* ſhall be,

*To find the greateſt* Common-Meaſure *to any two given* Numbers *whatever.*

*Divide* the greater *Number* by the leſſer, and if any Thing *remains*, make that *Remainder* a *Diviſor*, and the laſt *Diviſor* a *Dividend*; and ſo continue *dividing* the laſt *Diviſor* by the *Remainder*, till 0 *remains*; and that *Number* that *divides* or is the *Diviſor*, when 0 *remains*, is the greateſt *Number* that will *divide* the two given *Numbers*, without leaving a *Remainder*. As for Inſtance, Suppoſe I aſk, *What* Number *will bring* $\frac{340}{380}$ *to its loweſt Terms?* Or, *What is the greater* Number *that will* divide *both* 340 *and* 380, *and leave no* Remainder *in either?*

To effect this, I do as order'd above, thus:

340 | 380 | 1
340

40 | 340 | 8
320

20 | 40 | 2
40

00

And ſo find that 20 is the *biggeſt Number*, or *greateſt common Meaſure* to the *Fraction* given, or the two Numbers that compoſe the *Numerator* and *Denominator*.

N. B. *If* Unity *ſhould happen to be the laſt* Diviſor, *then are the given* Numbers *already in their loweſt* Terms, and are called, or ſaid to be *Prime* to one another. As, *What is the greateſt* common Meaſure *to* $\frac{111}{316}$?

175 | 316 (1
175
141 | 175 | 1
141
34 | 141 | 4
136
5 | 34 | 6
30
4 | 5 (1
4
1 | 4 | 4
4
0

*N.B.* The *Quotients*, be they ever ſo many in theſe *Operations*, are not regarded.

Here, after five *Diviſions*, the *Remainder* is 1, which becomes the next *Diviſor*, and conſequently, muſt have no *Remainder*; becauſe all *Numbers* whatever contain ſo many *Units* or 1's as *expreſs* themſelves; therefore $\frac{175}{316}$ are Numbers *prime* to *one another*, or ſuch as cannot be brought into lower *Terms*.

*What is the greateſt* common Diviſor *to* $\frac{504}{588}$ ?

504 | 588 | 1
504
84 | 504 | 6
504
00

Here it appears that 84 is the greateſt *common Diviſor* to $\frac{504}{588}$.

*What*

*What is the greateſt* common Meaſure *to* $\frac{918}{1998}$? *Anſ.* 54

918 | 1998 | 2
1836

162 | 918 | 5
810

108 | 162 | 1
108

54 | 108 | 2
108

00

*What is the greateſt* common Meaſure *to* $\frac{1751}{3502}$? *Anſ.* 1751

1751 | 3502 | 2
3502

0000

*What is the greateſt* common Meaſure *to* $\frac{316}{426}$? *Anſ.* 2

316 | 426 | 1
316

110 | 316 | 2
220

96 | 110 | 1
96

14 | 96 | 6
84

12 | 14 | 1
12

2 | 12 | 6
12

0

*To reduce or bring* Fractions *to their leaſt or loweſt* Terms, *ſtill retaining the ſame* Value *they had in the given or larger* Numbers.

## RULE.

You may find the greateſt *common Meaſure*, as was taught in the foregoing *Rule*, and *divide* the given *Numerator* and *Denominator* thereby, and the *Quotients* ſo ariſing will be a new *Fraction*, equal to the given one, and in its leaſt *equivalent Terms*.

*As, What's the loweſt* equivalent Terms *of* $\frac{117}{468}$ ? *Anſ.* $\frac{1}{4}$.

Here, working as was directed in the laſt *Rule*, I find 117 the *Numerator*, is exactly contained 4 *Times* in 468 the *Denominator*, ſo that 0 *remains*; by which I find 117 is the greateſt *common Meaſure* to the given *Fraction*; and that *dividing* the *Numerator* by 117, the *Quotient* is 1; and alſo dividing the *Denominator* by the ſaid 117, the *Quotient* is 4, and 0 remains in both *Diviſors*; which *Quotients* being put *Fraction-wiſe*, will ſtand thus, $\frac{1}{4}$; ſo that working any *Queſtion* with $\frac{1}{4}$ will produce the ſame *Anſwer*, when apply'd to *Coin*, *Meaſure*, *Weight*, &c. as working with $\frac{117}{468}$.

*What's the loweſt equivalent Terms of* $\frac{182}{234}$ ?

Here I find the greateſt *common Meaſure* to be 26, by which, *dividing* the given *Numerator* and *Denominator*, the *Quotients* ariſing are $\frac{7}{9}$, and 0 *remains*; ſo that $\frac{182}{234}$ is reduced to $\frac{7}{9}$, which is the loweſt *equivalent Terms* this given *Fraction* can be reduc'd into. After the ſame Manner you may proceed with any other *Fraction*, or a Number of *Fractions*; but as this is oftentimes very tedious and troubleſome, though abſolutely true; therefore you may (if you like it better) uſe the following

## CONTRACTIONS.

1*ſt*. If the *Numerator* and *Denominator* of the given *Fraction* end with a *Gypher*, or *Cyphers*, cut off the ſaid *Cypher* or *Cyphers*, if the *Number* is equal, from both the *Numerator* and *Denominator*, and work with the remaining Figures: Thus $\frac{20}{70}$ is equal to $\frac{2}{7}$, and $\frac{600}{980}$ is equal to $\frac{60}{98}$, and $\frac{1000}{8000}$ to $\frac{1}{8}$, &c.

2*d*. If the *Numerator* and *Denominator* given, end both with 5, or one with 5, and the other with 0, you may *divide* by 5. Thus $\frac{25}{75}$ is $\frac{5}{15}$, or $\frac{1}{3}$; ſo $\frac{20}{65}$ is $\frac{4}{13}$, and $\frac{55}{40}$ is $\frac{11}{8}$, &c.

3*dly*. If

3*dly*, If the given *Fraction* ends with even *Numbers*, you may *halve* or *divide* the *Numerator* and *Denominator* by 2, and these *Quotients* again by 2, if they come out even *Numbers*; and so on till one or both of the *Quotients* becomes an odd *Number*: Thus $\frac{8}{32}$ is $\frac{4}{16}$ is $\frac{2}{8}$ is $\frac{1}{4}$; so $\frac{12}{48}$ is $\frac{6}{24}$ is $\frac{3}{12}$ is $\frac{2}{6}$ is $\frac{1}{3}$, *&c.*

4*thly*, If the given *Numerator* and *Denominator* be both odd *Numbers*, or the one *even* and the other *odd*, you may try 3, 5, 7, 9, *&c.* always taking odd Numbers, because an even *Number* will not *divide* an odd one without leaving a *Remainder*; and if any of them succeed, you may try the new *Fraction* so arising, as has already been directed in the four *Articles* here taught you, till you can't find an *odd* Number to answer, and your Work is done. As $\frac{3}{12}$ is $\frac{1}{4}$ by dividing by 3, or $\frac{12}{3}$ is $\frac{4}{1}$. And Note, *When you bring either the given* Numerator *or* Denominator *into* Unity, *you can go no further.*

Suppose $\frac{117}{459}$ the *Fraction* above given.

Here dividing by 3, the new *Fraction* is $\frac{39}{153}$; this again by 3, and it produces $\frac{13}{51}$; and this by 13, is $\frac{1}{4}$, as before.

So the second Example $\frac{1232}{2340}$, being first halved, $\frac{91}{117}$ arises; this *divided* by 13, is $\frac{7}{9}$, as before; and so in all other *Cases* whatsoever, you may *divide* by any *Numbers*, *even* or *odd*, *big* or *little*, that will exactly *divide* both the *Numerator* and *Denominator*, without leaving a *Remainder*. As $\frac{284}{360}$, is $\frac{142}{180}$ and $\frac{142}{180}$ by *dividing* first by 5, according to *Note* 2d; and those *Quotients* $\frac{142}{180}$ by 3, according to *Note* the 4th. So $\frac{168}{192}$ being given, I divide by 8, and find it succeed, the *Quotients* being $\frac{21}{24}$; this I try with 3, and find $\frac{7}{8}$ come out. Thus you may do with any other *Numbers* or *Fractions* whatever. The reducing *Fractions* to their lowest Terms will be found of great Service hereafter, in greatly shortning the Labour which is otherwise required, especially in *Addition* and *Substraction*, where the *Fractions* must always have a common *Denominator* before you can use them; though in *Multiplication* and *Division* you may work both when the given *Fractions* have, and have not a common *Denominator*.

*To reduce, or bring* Fractions *that have different* Denominators, *to others, having a common* Denominator, *still retaining their original Value.*

RULE.

Multiply all the given *Denominators* together, for a *new* and common *Denominator*, and each *Numerator* into all

the *Denominators*, excepting its own, for ſo many new *Numerators*, as bring $\frac{2}{3}$ and $\frac{4}{7}$ into *equivalent Fractions*, having a common *Denominator*.

Thus $\frac{2}{3}$ and $\frac{4}{7}$ being given, $\frac{10}{15}$ and $\frac{12}{15}$ will ariſe, which are equal to the given *Fractions*, as may be eaſily try'd; for, 'tis plain, $\frac{2}{3}$ is equal to $\frac{10}{15}$; for abbreviating $\frac{10}{15}$, you will find it come to $\frac{2}{3}$, the original *Fraction*; and by abbreviating $\frac{12}{15}$, you will have $\frac{4}{7}$ come out. So if $\frac{2}{7}$ and $\frac{6}{9}$ *were given*, you would have $\frac{18}{63}$, and $\frac{42}{63}$ come out; for by *multiplying* 7 and 9, the given *Denominators* together, 63 comes out, for the common *Denominator*; and by *multiplying* 2, the *Numerator* of $\frac{2}{7}$ by 9 the *Denominator* of $\frac{6}{9}$, the other given *Fraction*, the *Product* 18 is a new *Numerator* to the common *Denominator* 63, inſtead of 2 the *Numerator* to $\frac{2}{7}$, and inſtead of 6 the *Numerator*, to the given *Denominator* 9, you have 42 ariſing by *multiplying* 6, the given *Numerator*, into the contrary given *Denominator*.

Bring $\frac{1}{6}$, $\frac{7}{8}$, $\frac{2}{12}$, and $\frac{11}{15}$ into *Fractions*, having a common *Denominator*.

| | 5 | 7 | 9 | 13 |
|---|---|---|---|---|
| | 8 | 6 | 8 | 12 |
| 6 | | | | |
| 8 | 40 | 42 | 72 | 156 |
| | 12 | 12 | 6 | 8 |
| 48 | | | | |
| 12 | 480 | 504 | 432 | 1248 |
| | 15 | 15 | 15 | 6 |
| 576 | | | | |
| 15 | 2400 | 2520 | 2160 | 7488 |
| | 480 | 504 | 432 | |
| 2880 | | | | |
| 576 | 7200 | 7560 | 6480 | |
| | | | | |

8640 common Denominator.

Here $\frac{1}{6}$ becomes $\frac{1440}{8640}$, and $\frac{7}{8}$ is $\frac{7560}{8640}$, and $\frac{2}{12}$ is $\frac{720}{8640}$, and $\frac{11}{15}$ is $\frac{7488}{8640}$.

N. B. *When any of the given* Fractions *can be abbreviated, or expreſſed in leſſer Terms than thoſe given, 'tis the beſt way always ſo to do.* As above, $\frac{2}{12}$ might have been reduced into $\frac{1}{4}$; and then the Expreſſions would have been $\frac{1440}{5760}$ for $\frac{1}{6}$; $\frac{7560}{30240}$ for $\frac{7}{8}$; and $\frac{1080}{4320}$ for $\frac{2}{12}$ reduced to $\frac{1}{4}$, and $\frac{7488}{29952}$ for $\frac{11}{15}$.

If

If any of the other *Fractions* could alſo have been reduced lower, the common *Denominator* would have been expreſſed in ſtill leſſer *Terms*, as in the *Example* following.

Bring $\frac{7}{17}$, and $\frac{6}{20}\frac{152}{168}$, and $\frac{11}{306}$ to a common *Denominator*. Firſt working according to the general Directions, the Matter will ſtand thus:

| | |
|---|---|
| 26168 | 8007408 |
| 306 | 171 |
| 157008 | 8007408 |
| 785040 | 56051856 |
| 8007408 | 8007408 |
| 513 | 1369266768 |
| 24022224 | |
| 8007408. | |
| 40037040.. | |
| 4107800304 the common Denominator. | |

| | |
|---|---|
| 513 | 26168 |
| 306 | 513 |
| 3078 | 78504 |
| 15390 | 26168. |
| 156978 | 130840.. |
| 6542 | 13424184 |
| 313956 | 153 |
| 627912. | 40272552 |
| 784890.. | 67120920. |
| 941868... | 13424184.. |
| 1026950076 | 2053900152 |

Here $\frac{7}{17}$, is $\frac{1756226647684}{4107800304}$, and $\frac{6}{20}\frac{152}{168}$ is $\frac{1026950076}{4107800304}$, and $\frac{11}{306}$ is $\frac{2053900152}{4107800304}$.

But by *reducing* theſe given *Fractions* to their loweſt *Terms*, they become $\frac{4}{7}$, $\frac{1}{4}$ and $\frac{1}{2}$, which is $\frac{8}{14}$, $\frac{3}{14}$ and $\frac{7}{14}$. Do the ſame upon all Occaſions, whenever the given *Fractions* will admit it.

*To reduce an improper* Fraction *to a whole or mix'd* Number.

Divide the *Numerator* by the *Denominator*, and if 0 *remains*, the *Quotient* is the whole *Number*, equal to the given *Fraction*; but if any thing *remains*, the *Quotient* is the whole *Part*, and the *Remainder* is the *Numerator* of the *Fractional Part*, and the given *Denominator* is the *Denominator* to this new *Fraction*.

*What is the whole or mix'd* Number *equal to* $\frac{5113}{171}$? Anſ. 3 *whole* Numbers.

*What is the whole or mix'd* Number *to* $\frac{648}{24}$? Anſ. 27 $\frac{12}{24}$, or $\frac{1}{12}$, that is 27 whole *Numbers*, and $\frac{12}{24}$ *Parts* of a whole *Number*, which being *reduc'd* is $\frac{1}{12}$.

Note, *Upon all Occaſions, where there's a ſingle* Fraction, *'tis beſt to expreſs it in its loweſt* Terms.

*To reduce a whole* Number *into an improper* Fraction.

This *Rule* conſiſts of 2 Parts: *Firſt*, when there is no *Denominator* aſſign'd: *Secondly*, when there is one aſſign'd.

In the firſt *Caſe*, draw a Line under the given Number, and make it the Numerator, and put 1 or Unity under the Line for a Denominator. As,

Bring 28 into an improper *Fraction*.

Here doing as above directed, the Work will ſtand thus, $\frac{28}{1}$.

In the ſecond *Caſe* multiply the whole *Number* given, by the *Denominator* given, and make that *Product* the *Numerator*, and under it write the given *Denominator*; and this *Fraction* will be the Anſwer required. As,

*What is the improper* Fraction *to* 48, when 9 is the *Denominator?*

Here *multiplying* 48, the whole *Number* given, by 9, the *Product* 432 is the *Numerator*, and the *Fraction* ſought, is $\frac{432}{9}$; and ſo proceed with all whole *Numbers*, whether great or ſmall.

*To reduce a mix'd* Number *to an* improper Fraction.

*Multiply* the *integral* or whole *Part* of the given mix'd *Number*, by the *Denominator* of the Fractional *Part*, and to that *Product* add the *Numerator* of the Fractional *Part*, and this *Sum* will be a new *Numerator* to the *Denominator* of the Fractional *Part* given; and this new *Fraction* will be the improper *Fraction* ſought, as in the following *Examples*.

*What's*

*What's the* improper Fraction *to* 26 $\frac{5}{8}$?

Here *multiplying* 26 by 8, the *Product* is 208, to which *add* 5, the Sum is 213; to which put 8, the given *Denominator*, and the new *Fraction* is $\frac{213}{8}$, the *Fraction* required.

*To expreſs the* Proportion *that any one, two, three or more* Fractions *have one to another, in whole* Numbers.

*Firſt*, If it be required to know what *Proportion* the *Numerator* bears to the *Denominator* of any *Fraction*; if it be a *Compound* one, you muſt *reduce* it to a *ſingle* one, and then reduce it to its loweſt *Terms*, and the *Numbers* expreſſing the *Fraction* ſo *reduced*, will be the *Numbers* ſought. But if the *Fraction* given be a *ſingle* one, whether *proper* or *improper*, you have nothing to do but reduce it to its loweſt *Terms*, and the new *Fraction* is the *Anſwer* ſought. So if the *Queſtion* was made by a mix'd *Number*, firſt *reduce* it to an improper *Fraction*, in its loweſt *Terms*, and the *Numerator* and *Denominator* ſo *reduced* is the *Anſwer*.

*Secondly*, If the given *Fractions* have a common *Denominator*, then the *Numerators* are the whole *Numbers* that expreſs the *Proportion*; and if they can be reduc'd lower, you may do it, as in the following *Example*.

*What are the whole* Numbers *that expreſs the* Proportion *of* $\frac{3}{7}$ *to* $\frac{6}{7}$?

Here, rejecting the common *Denominator*, the *Anſwer* will be 3 and 6, *that is*, the two given *Fractions* will have the ſame *Proportion* to one another, as the whole *Numbers* 3 and 6 have to one another. And as 3 and 6 may both be *divided* by 3, the *Quotients* 1 and 2 will ſhew the Proportion to be as 1 is to 2, or what is called *Sub-duple*.

*Thirdly*, If the given *Fractions* have not a common *Denominator*, then reduce them to *Fractions* that have a common *Denominator*, and work as above. As,

*What* Proportion *has* $\frac{2}{3}$ *to* $\frac{1}{5}$?

Here I find the two given *Fractions*, when *reduced* to a common *Denominator*, will be $\frac{10}{15}$, and $\frac{3}{15}$; ſo that their *Proportion* is as 10 is to 3, which are *Numbers prime* to one another; becauſe they cannot be *reduced* any lower, or have no other common *Diviſor* but *Unity*.

*What* Proportion *is between* $\frac{2}{3}$ *of* $\frac{1}{6}$ *of* $\frac{2}{13}$?

*Anſwer*. The *Numerator* is to the *Denominator*, as 5 to 13; for having reduc'd the compound *Fraction* to a *ſimple one*, it comes to $\frac{20}{234}$; which being *reduced* to its loweſt

*Terms* is $\frac{5}{13}$; ſo that the whole *Numbers* 5 and 13, are the whole *Numbers* that expreſs their true *Proportion* in the loweſt *Terms*.

*Expreſs the* Proportion *of* $\frac{8}{18}$ *in its loweſt* Terms, *in whole* Numbers.

Here *abbreviating* $\frac{8}{18}$ it comes to $\frac{4}{9}$; ſo that this *Fraction* is as 4 to 9.

*What's the* Proportion *of* $\frac{7}{9}$ *in whole* Numbers?

This being a *Fraction*, whoſe *Numerator* is *prime* to its *Denominator*, the Anſwer in whole Numbers is as 7 to 9.

*Expreſs in whole* Numbers *the* Proportion *of* $\frac{2}{3}\frac{1}{7}$ *to* $\frac{2}{3}\frac{6}{2}$.

Firſt *reducing* each *Fraction* to its loweſt *Terms*, I find $\frac{2}{3}\frac{1}{7}$ comes to $\frac{1}{3}$, and $\frac{2}{3}\frac{6}{2}$ to $\frac{11}{16}$; and theſe new *Fractions* being reduced to a common *Denominator*, they are $\frac{16}{48}$, and $\frac{33}{48}$.

Here rejecting, or throwing away the common *Denominator*, the *Numerators* not admitting of a common *Diviſor*, or of being reduc'd to lower *Terms*, the ſaid *Numerators* are the *Numbers* ſought, *viz.* the given *Fractions* are in *Proportion* to one another, as 16 to 39. After the ſame Manner you may do with 3, 4, 5, *&c.* given *Fractions*.

*To find the Value of any given* Fractions *in the known Parts of* Coin, Weight, Meaſure, *&c.*

*Multiply* the *Numerator* by the Number of *Parts* in the next inferior *Denomination*, and *divide* that *Product* by the *Denominator*, and the *Quotient* is the *Anſwer*; and if any thing remains, *multiply* that *Remainder* by the *Number* of known *Parts* in the next inferior *Denomination* to that laſt found; and ſo continue *multiplying* and *dividing*, till either nothing *remains*, or you have gone through all the *Subdiviſions* of the *Coin*, *Weight*, *Meaſure*, &c. mentioned in your *Queſtion*: As in the following *Examples* will fully appear.

*What's the Value of* $\frac{3}{4}$ *of a* Guinea?

21 *Shillings* in a *Guinea*.

3

4 | 63 *Product*.

15 *Shillings* and 3 *remains*.

12 *Pence* is a *Shilling*.

4 | 36

9 *Pence* and 0 *remains*.

| | *s.* | *d.* |
|---|---|---|
| *Anſ.* | 15 | 9 |

*What's*

*What's the Value of* $\frac{7}{8}$ *of a* L. Sterling?

7
20 *Shill.* is a L. *Ster.*

8 | 140

17 *Shillings* and 6 *Pence.*

4 remains.
12

8 | 48

s. d.
Anſ. 17 6

*What's the Value of* $\frac{5}{9}$ *of a* L. Sterling?

5
20

9 | 100

11 *Shillings* and 1 remains.

12

9 | 12

1 Penny and 3 remains.

4

9 | 12

s. d. f.
Anſ. 11 : 9 : 1 and $\frac{1}{3}$ of a Far.

1 Far. and $\frac{3}{9}$ or $\frac{1}{3}$

*What is the Value of* $\frac{13}{17}$ *of a Day?*

13
24 *Hours* in a *Day.*

52
26

17 | 312 | 18 *Hours.*
17

142
136

6 *Parts* of an *Hour.*

6 *Parts*

6 *Parts* of an *Hour.*
60 *Minutes* in an *Hour.*

17 | 360 (21 *Minutes.*
34
20
17
3 (*Parts* of a *Minute.*
60
180 (10 *Seconds.*
17
10 *Parts* of a *Second.*

Anſwer, 18 *Hours*, 21 *Minutes*, 10 *Seconds*, and $\frac{10}{17}$ of a *Second.*

*What's the Value of* $\frac{131}{216}$ *of a* ℔ *Troy?*

131
12 *Ounces* in a ℔ *Troy.*

216 | 1562 | 7 *Ounces.*
1512
50 *Parts* of an *Ounce.*
20 Dwts in an *Ounce.*

1000 | 4 *Penny Weights.*
864
136 *Parts* of a *Penny Weight.*
24 *Grains* in a *Penny Weight.*

544
372

216 | 4264 | 19
216
2104
1944
160 Parts of a Grain, or $\frac{20}{27}$ of a Grain.
216

So

So let the *Coin*, *Weight*, or *Meaſure*, be what it will, the *Law* of Procedure is always the ſame.

*To reduce or turn* Fractions *or whole* Numbers *of one* Denomination *into another of a greater or leſſer* Value, *ſtill retaining their true Value.*

If the given *Fractions* or whole *Numbers*, are to be chang'd into *Parts* of a higher Species, or Name, you muſt put thoſe given firſt, and the ſeveral aſcending Parts of the Species required, following, in the Form of a compound *Fraction*, making *Unity* the *Numerator* to every one of the *Subdiviſions*, and the *Number* of the *Subdiviſion* the *Denominator*. As, What Part of a *Pound* Sterling is 3 *Farthings*? Here the given *Number*, of itſelf, is a whole *Number*, viz. 3 *Farthings*; the next *Subdiviſion* upwards is a *Penny*. Now 4 *Farthings* making a *Penny*, conſequently the given whole *Number*, is $\frac{1}{4}$ of a *Penny*, and a *Penny* is the $\frac{1}{12}$ of a *Shilling*, and a *Shilling* is the $\frac{1}{20}$ of a *Pound* Sterling: So that it muſt be expreſs'd thus: $\frac{1}{4}$ of $\frac{1}{12}$ of $\frac{1}{20}$, which is equal to $\frac{1}{960}$ or $\frac{1}{320}$; ſo that 3 *Farthings* is the $\frac{1}{320}$ of a Pound *Sterling*. Obſerve the ſame Method, let the *Names* be what they will.

*Secondly*, If the given *Fractions* or whole *Numbers*, are to be chang'd into the Species of the leſſer Name, you muſt make the Number of the deſcending Species, the Numerator, and Unity the Denominator. As,

*What Part of a* Farthing *is* $\frac{3}{5}$ *of a Pound* Sterling? $\frac{3}{5}$ of $\frac{20}{1}$ of $\frac{12}{1}$ of $\frac{4}{1}$. Anſ. $\frac{1440}{3}$ or 640 *Farthings*.

*What Part of a Pound* Sterling *is* $\frac{7}{8}$ *of a* Guinea?

$\frac{7}{8}$ of $\frac{21}{20}$ is $\frac{147}{160}$.

*What Part of a* Guinea is $\frac{7}{8}$ of *a Pound* Sterling?

$\frac{7}{8}$ of $\frac{20}{21}$ is $\frac{140}{168}$ or $\frac{5}{6}$.

## *Addition of* FRACTIONS.

If the given *Fractions* have not a *common Denominator*, they muſt be reduced to *Fractions* that have a *common Denominator*; or if they relate to any particular *Species*, of *Money*, *Weight*, *Meaſure*, &c. they muſt be reduced to all of one *Name*; and then to *Fractions* of a *common Denominator*; then add the *Numerators* together, and to their Sum ſubſcribe the *common Denominator*, and that *Fraction* is the *Anſwer*, which if an *improper* one, you muſt reduce it to a whole or mix'd *Number*, as formerly directed.

## EXAMPLES.

*What is the* Sum *of* $\frac{1}{7}$ *and* $\frac{1}{7}$? Anſwer $\frac{2}{7}$.

*What is the* Sum *of* $\frac{1}{8}$ *and* $\frac{7}{8}$? Anſwer $\frac{8}{8}$ or 1 and $\frac{}{8}$, or $\frac{1}{4}$.

*What is the* Sum *of* $\frac{1}{2}$ *and* $\frac{2}{3}$? Anſwer, $\frac{7}{6}$ or $1\frac{1}{6}$.

*What is the* Sum *of* $\frac{2}{3}$ *and* $\frac{1}{9}$, *and* $\frac{1}{3}$?

Here $\frac{1}{9}$ may be *reduced* to $\frac{1}{3}$, which *added* to $\frac{2}{3}$, makes $\frac{3}{3}$ or 1; ſo that the *Anſwer* is 1 and $\frac{1}{3}$.

*What is the* Sum *of* $\frac{1}{9}$, $\frac{6}{8}$, $\frac{4}{7}$ *and* $\frac{1}{6}$?

Note, *Always reduce any or all of the given* Fractions *to their loweſt* Terms, *before you go about to reduce them to a* common Denominator.

As in this Example: I reduce $\frac{6}{8}$ to $\frac{3}{4}$, and then I find the *common Denominator* to be 1080, and the ſeveral *Numerators*, 600, 810, 864 and 900, whoſe *Sum* is $\frac{3174}{1080}$, which being reduced, the Anſwer is $2\frac{1014}{1080}$, or $2\frac{169}{180}$.

*What is the* Sum *of* $\frac{5}{9}$ *of* $\frac{6}{7}$ *of* $\frac{2}{3}$ *and* $\frac{3}{4}$ *of* $\frac{5}{6}$ *of* $\frac{1}{3}$?

Here the compound *Fractions* being reduc'd to ſimple *ones*, they become $\frac{60}{189}$ and $\frac{15}{72}$, or $\frac{20}{63}$ and $\frac{5}{96}$; which reduced to a *common Denominator*, is $\frac{180 \text{ and } 126}{567}$, whoſe *Sum* is $\frac{306}{567}$, or $\frac{14}{21}$.

Sometimes the Labour of reducing may be ſhortned by *multiplying* one of the given *Fractions*, by a *Number* that ſhall make its *Denominator* equal to the other, as above, $\frac{2}{9}$ being *multiply'd* by 7, becomes $\frac{14}{63}$, which added to the other $\frac{20}{63}$ comes to $\frac{34}{63}$, the ſame with the common Method, but much ſhorter. You may obſerve the like in all Caſes that will admit of it.

*What is the* Sum *of* $\frac{1}{9}$ *of a* Guinea, *and* $\frac{2}{3}$ *of a L.* Sterling?

Here you may firſt make the 2 *Fractions* both Parts of a Guinea, or of a Pound, as you beſt like: See it done both Ways: $\frac{1}{9}$ of a Guinea is $\frac{1}{9}$ of $\frac{21}{20}$ of a *Pound*, which is $\frac{21}{180}$ or $\frac{7}{60}$ of a *L.* which added to $\frac{2}{3}$ is $\frac{47}{60}$, or *L.* 1 $\frac{3}{12}$ or $\frac{1}{4}$,

equal

equal to *L.* 1 : 5 : 0. The other Way : $\frac{3}{5}$ of a *L.* is $\frac{3}{5}$ of $\frac{40}{63}$ or $\frac{40}{63}$ of a Guinea, which added to $\frac{1}{3}$ of a Guinea, makes a Guinea, or $1\frac{2}{63}$, or $\frac{4}{21}$. Now a Guinea is *L.* 1 : 1 and $\frac{1}{21}$ is - - - - - - 4

*L.* 1 : 5 : 0 *Total*

as before.

*What is the* Sum *of* $\frac{2}{3}$ *of an* Ell Engliſh, *and* $\frac{1}{4}$ *of an* Ell Flemiſh?

Here $\frac{2}{3}$ of an *Ell Engliſh* is $\frac{2}{3}$ of $\frac{3}{5}$ of an *Ell Flemiſh*, which is $\frac{10}{15}$ or $1\frac{1}{5}$ *Ell Flemiſh*; this added to $\frac{1}{4}$ is $\frac{4}{16}$, $\frac{31}{16}$ or $1\frac{11}{16}$ *Ell Flemiſh*; but if you bring the $\frac{1}{4}$ of an *Ell Flemiſh* into Parts of an *Ell Engliſh*, twill be $\frac{1}{4}$ of $\frac{1}{5}$ which is $\frac{2}{20}$; this added to $\frac{2}{3}$ is $\frac{40}{60}$, and $\frac{47}{60}$, or $\frac{47}{00}$, which is 1 and $\frac{7}{60}$ *Ell Engliſh*. Now $1\frac{11}{16}$ *Ell Flemiſh*, is 5 *Quarters* of a *Yard*; and $\frac{7}{12}$ and $1\frac{7}{60}$ of an *Ell Flemiſh* is the ſame, which ſhews both *Anſwers* to be the ſame. You muſt go on after the ſame Manner, let the *Name* or *Denomination* be what it will.

### *Subſtraction of* FRACTIONS.

Here the ſame preparative Work muſt be had, as in the laſt *Rule*, viz. if the given *Fractions* have not a common *Denominator*, they muſt be *reduced* to ſuch as have, whether they are *ſimple*, *compound* or *improper Fractions*; then *taking* or *ſubſtracting* the *Numerator* out of the *Denominator*, the *Remainder* is the *Anſwer* ſought.

As, *What is the Difference between* $\frac{3}{8}$ *and* $\frac{1}{8}$? Anſwer $\frac{2}{8}$, or $\frac{1}{4}$.

*What is the Difference between* $\frac{1}{6}$ *and* $\frac{3}{8}$? Anſwer $2\frac{1}{24}$. When reduced they are $\frac{40}{40}$, and $\frac{15}{40}$, whoſe Difference is $\frac{25}{40}$ or $\frac{1}{24}$.

*Subſtract* $\frac{1}{4}$ of $\frac{1}{9}$ from $\frac{8}{9}$, and tell the Difference.

Theſe *reduced*, are $\frac{1}{36}$ and $\frac{32}{36}$, whoſe Difference is $\frac{17}{36}$.

From $\frac{8}{7}$ take $\frac{2}{3}$. *Reduced* they are $\frac{24}{21}$, and $\frac{14}{21}$, Difference is $\frac{10}{21}$.

From 5 take $\frac{1}{3}$.

Here being but one *Fraction*, ſubſtract the *Numerator* out of the *Denominator*, and abate *one* or *Unity* from the whole *Number*, and the *Remainder* is the *Anſwer*. As here $4\frac{2}{3}$ is the *Remainder* or *Difference*.

*Subſtract* $6\frac{3}{4}$ out of $8\frac{1}{4}$.

Here the *Fractions*, being of a common *Denominator*, I ſay 2 out of 1 I cannot, but I borrow *Unity*, which in this Inſtance is 5, becauſe the common *Denominator* is 5; and ſay, 2 out of 6, the *Sum* of *Unity*, and the *Numerator* of the *Number* given, from which the *Subſtraction* is to be made,

and the *Remainder* is 4; then I ſay, 6 out of 7, becauſe 1 was borrowed from the 8 to ſupply the *Fraction* that was *deficient*; ſo that the *Anſwer* is 1 and $\frac{4}{7}$.

Or you might have *reduced* both the given *Fractions* to *improper Fractions*, and have *ſubſtracted* the *leſſer* from the *greater*, and the *Remainder* would have been $\frac{2}{7}$ or 1 $\frac{4}{7}$; for the *Fractions* ſo *reduced* will be $\frac{41}{7}$, and $\frac{12}{7}$, whoſe Difference is $\frac{2}{7}$ or 1 $\frac{4}{7}$, as above. *Do the ſame in all like Caſes.*

Take 165 $\frac{2}{3}$ out of 318 $\frac{5}{7}$.

Here I *reduce* the *Fractional Parts* of the given *Number* into a common *Denominator*, and then they will ſtand thus:

318 $\frac{15}{21}$
165 $\frac{14}{21}$

Whoſe *Difference* is 153 $\frac{1}{21}$

*Subſtract* $\frac{2}{7}$ of a *Moidore* out of $\frac{2}{3}$ of a *double Guinea*, or Piece worth 42 Shillings, and tell the *Difference*.

$\frac{2}{7}$ of a *Moidore* is $\frac{2}{7}$ of $\frac{2}{42}$ of a *double Guinea*, which is $2\frac{14}{49}$, or $\frac{2}{49}$; this out of $\frac{2}{3}$ leaves $1\frac{74}{147}$ of a *double Guinea* for the *Difference*, which is equal to 10 s. 1d. 2 f. $\frac{6}{7}$.

*What's the* Difference *between* $\frac{2}{3}$ *of an* Hour, *and* $\frac{1}{3}$ *of a* Day?

$\frac{1}{3}$ of a *Day* is $\frac{1}{3}$ of $\frac{24}{7}$ of an *Hour*, equal to 8 *Hours*; ſo that the *Anſwer* is 7 *Hours*, and $\frac{1}{7}$ of an *Hour*.

Take *L.* 2 : 17 : 6 out of 5 Guineas, and $\frac{1}{4}$.

Here I find the Value of the 5 Guineas and $\frac{1}{4}$ to be *L.* 5 : 9 : 2 : 1 $\frac{1}{4}$, from which taking 2 : 7 : 6 the Difference or Anſwer

is 2 : 1 : 8 : 1 $\frac{1}{4}$

*Multiplication of* FRACTIONS.

Here, if any or all of the given *Fractions* are compounded, they muſt be brought into *ſimple Fractions*; or if they are whole or mix'd *Numbers*, they muſt be made *improper Fractions*; and then *multiply* the *Numerators* by the *Numerators*, for a new *Numerator*, and the *Denominators* together for a new *Denominator*; and the new *Fraction* ſo produced is the *Anſwer* ſought.

*What's the* Product *of* $\frac{1}{7}$ multiply'd *by* $\frac{1}{4}$? Anſwer $\frac{1}{28}$.

*What's the* Product *of* $\frac{2}{3}$ *of* $\frac{12}{17}$ of $\frac{6}{11}$ multiply'd by 8 $\frac{2}{7}$?

Here

Here the compound *Fraction* reduced, is $\frac{1}{9}\frac{1}{3}\frac{2}{24}$, and the mix'd *Number* is $1\frac{1}{7}$; *multiply'd* together, they make $1\frac{1}{6}\frac{1}{1}\frac{2}{24}$, or $2\frac{4}{16}\frac{1}{3}\frac{1}{1}$.

Here may very properly come in the famous Queſtions of multiplying *Money*, *Weight*, *Meaſure*, &c. by *Money*, *Weight*, *Meaſure*, &c. For though, properly ſpeaking, no ſuch thing is poſſible, in the Nature of *Numbers*, all *Multiplication* being only a Repetition of one *Number* or *Thing*, a certain *Number* of *Times*; yet as many *Smatterers* in this *Art*, imagine they are capable of doing ſtrange Things, when they are only able to do ſuch-like *Queſtions* mechanically, without knowing the *Reaſons* or *Demonſtrations* of the *Proceſs*, I will here ſhew you how you may do any thing of that Nature, and upon what *Foundations* ſuch *Operations* are *built*.

*Firſt*, You are to conſider what *Species* of *Money*, *Weight*, *Meaſure*, &c. you will make the *Integer*. As, ſuppoſe I ſay, *What's the* Product *of* 3 *Quarters by* 3 *Quarters in* Cloth Meaſure? or 5 *Yards* by 5 *Yards* in *Long Meaſure?* or 2 *Pounds* by 5 *Pounds?* or 3s. 4d. by 6s. 8d. in *Engliſh* or *Sterling Money*, &c. Here, where there is only one Name mention'd, you need only conſider them as *plain* or whole *Numbers*: As in the firſt Inſtance of 3 *Quarters* by 3 *Quarters* in *Cloth-Meaſure*, the *Engliſh Yard* being the common Standard, I ſay the *Product* is 9 *Quarters*: That is, Suppoſe a Piece of Cloth 3 *Quarters* wide, and 3 *Quarters* long, you might cut 9 Pieces out of it, each one *Quarter* broad, and one *Quarter* long; but though the ſame Method is us'd in *Money*, yet the *Anſwer* cannot really be the ſame; for if I was to ſay, *multiply* 3 *Shillings* by 3 *Shillings*, the *Anſwer* would be called 9 *Shillings*; the *Anſwer* is fallacious, becauſe the Queſtion is ſo; for 'tis really the *Number* 3, applied to that Species of *Money* called *Shillings*, repeated 3 *Times*, and to the *Product* the common *Denomination* is applied, becauſe as there are 3 Units in the *Multiplicand*, ſo there are 3 Units in the *Multiplier*, which being collected by *Addition* or *Multiplication* into one *Sum*, produces 9 *Units*, to which you apply ſome common Name of *Money*, *Weight*, *Meaſure*, &c. But if you conſider the *Quarters* as Parts of a *Yard*, or the *Shillings* as Parts of a *Pound*, they will ſtand thus, $\frac{1}{4}$ by $\frac{1}{4}$, equal to $\frac{2}{16}$ in the firſt Inſtance; or $\frac{1}{20}$ by $\frac{1}{20}$ equal to $\frac{2}{400}$, in the ſecond Inſtance; that is, ſuch a Piece of *Cloth* would be $\frac{2}{16}$ of another Piece of *Cloth*, whoſe Length and Breadth was each one *Yard*, or ſuch a *Sum* of *Money* would be $\frac{2}{400}$ of *twenty Shillings*, repeated 20 *Times*. The ſame is to be ob-

ſerv'd of all the *Species* of applicate *Numbers* whatever, whether *Time*, *Weight*, &c. As ſuppoſe I aſk, What is the *Product* of 3 s. 4 d. *multiply'd* by 6 s. 8 d? Here you muſt conſider whether you will make a *Shilling* or a *Pound* the *Integer*. To make the Matter plain, I will do it both Ways; and firſt, by conſidering a *Shilling*, as the *Integer*, 3 s. 4 d. will be 3 s. $\frac{1}{3}$ or $\frac{10}{3}$ s. and 6 s. 8 d. will be 6 s. $\frac{2}{3}$, or $\frac{20}{3}$ s. whoſe *Product* is $\frac{200}{9}$ s. or 22 s. $\frac{2}{9}$, which may be called 22 s. and $\frac{2}{9}$; but if you make a *Pound* the *Integer*, 3 s. 4 d. will be $\frac{1}{6}$ and 6 s. 8 d. will be $\frac{1}{3}$ of a *Pound*, whoſe *Product* is $\frac{1}{18}$ of a *Pound*, or 20 *Shillings* repeated 20 Times, or $\frac{1}{18}$ of 400, as will plainly appear by making it a compound *Fraction*: Thus $\frac{1}{18}$ of $\frac{400}{1}$ is $\frac{400}{18}$ equal to 22 $\frac{2}{9}$, as before. So if you was aſk'd, What was the *Product* of *L.* 3, 4, 9 *multiply'd* by *L.* 7, 8, 6? Here I firſt turn *L.* 3 : 4 : 9 into a mix'd *Number*, and it is 3 $\frac{18}{80}$; then *L.* 7 : 8 : 6 is 7 $\frac{17}{40}$; theſe *reduc'd* to *improper Fractions* are $\frac{258}{80}$, and $\frac{297}{40}$.

| | |
|---|---|
| 297 | 80 |
| 259 | 40 |
| 2673 | 3200 |
| 1485. | |
| 594.. | |
| 76923 new Numerator. | |
| 3200 new Denominator. | |

Here the *Anſwer* is *L.* 24 $3\frac{123}{200}$, or, *L.* 24 : -- : 09 $3\frac{720}{800}$, or $\frac{9}{40}$ of a *Penny*.

You have been formerly taught to *multiply Money*, *Weights*, *Meaſures*, &c. by whole Numbers. Now you ſhall ſee the Reaſon and Demonſtration thereof: In the *Example* above, where 'tis plain that the *Name* or *Species* of *Coin*, called a *Pound* or twenty *Shillings*, is the *Integer*, and the 4 s. 9 d. is, are *Parts* of that *Integer*, as appears above by making it a mix'd *Number*, conſiſting of 3 whole *Numbers* or *Integers*, and $\frac{18}{80}$ *Parts* of an *Integer*; and the *L.* 7 : 8 : 6 alſo, are 7 *Integers*, and $\frac{17}{40}$ Parts of an *Integer*. Conſequently, either of theſe *multiply'd* by each other, muſt neceſſarily produce

produce the ſame Amount: As here, $7\frac{17}{40}$ *multiply'd* firſt by - - - - 3

The *Product* is $22\frac{11}{40}$

Then 4 s. is $\frac{1}{5}$ of a *Pound*; and as *multiplying* any *Number*, whether *whole* or *mix'd*, by a *Fraction*, whoſe *Numerator* is *Unity*, is the ſame Thing as *dividing* by the *Denominator*, conſequently $7\frac{17}{40}$ *multiply'd* by $\frac{1}{5}$, the *Product* muſt be $1\frac{12}{40}$, and $\frac{1}{5}$ of $\frac{1}{40}$; then 6 d. is $\frac{1}{40}$ L. and the *Product* ariſing from *multiplying* $7\frac{11}{40}$ by $\frac{1}{40}$ is $\frac{7}{40}$ and $\frac{12}{40}$ of $\frac{1}{40}$, or $\frac{12}{1600}$; then 3 d. is the $\frac{1}{80}$ of a Pound, or the $\frac{1}{2}$ of 6 d. So that multiplying $7\frac{17}{40}$ by $\frac{1}{80}$, is the ſame Thing as taking the $\frac{1}{2}$ of $\frac{7}{40}$, and $\frac{12}{1600}$, both coming to $\frac{1}{40}$ and $\frac{17}{3200}$. Now *collecting* theſe ſeveral *Products* together, they will ſtand thus:

$22\frac{11}{40}$
$1\frac{12}{40}$ more $\frac{1}{200}$ equal to $\frac{12}{3200}$
$\frac{7}{40}$ more $\frac{12}{1600}$ equal to $\frac{24}{3200}$
$\frac{1}{40}$ more $\frac{17}{3200}$ equal to $\frac{17}{3200}$

L. 24 and $\frac{0121}{3200}$

More neatly thus: $7\frac{40}{17}$

$22\frac{11}{40}$
$1\frac{12}{40}$ more $\frac{1}{5}$
$\frac{7}{40}$ more $\frac{2}{5}$ more $\frac{1}{8}$
$\frac{1}{40}$ more $\frac{1}{2}$ more $\frac{4}{8}$ more $\frac{1}{2}$

$24\frac{1}{40}$ more $\frac{1}{5}$ more $\frac{1}{8}$ more $\frac{1}{2}$ *Total.*

Now the 24 are ſo many whole *Numbers* or *Pounds*, and the ſeveral *Fractions* are to be thus read;

$\frac{1}{40}$ of a Pound, equal to - - - - $\frac{80}{3200}$
more $\frac{1}{5}$ of $\frac{1}{40}$ of a Pound, or $\frac{1}{200}$ equal to $\frac{12}{3200}$
more $\frac{1}{8}$ of $\frac{1}{200}$ of a Pound, or $\frac{1}{1600}$ equal to $\frac{2}{3200}$
more $\frac{1}{2}$ of $\frac{1}{1600}$ of a Pound, or $\frac{1}{3200}$

Total $\frac{121}{3200}$ which

which $3\frac{19}{20}\frac{11}{00}$ brought into the inferior Denominations of a *Pound*, comes out 9 *Pence*, and $3\frac{19}{200}$ or $\frac{2}{40}$ of a *Penny*, which is $\frac{2}{10}$ of a *Farthing*.

I will do the ſame Example again, and change the Multiplier, thus:

| L. 3 : 4 : 9, or | $3\frac{19}{80}$ multiply'd. |
|---|---|
| by 7 : 8 : 6 is | $22\frac{11}{80}$ |
| Note the Mark + ſtands for the Word *more*, and = for the Words *equal to*; ſo $\frac{11}{80}+\frac{4}{5}$, is $\frac{11}{80}$ more $\frac{4}{5}$; but here this $\frac{4}{5}$ is not $\frac{4}{5}$ of *Unity*, but $\frac{4}{5}$ of $\frac{1}{80}$, being the Remainder after the *Diviſion* by 5. | $\frac{11}{80}+\frac{4}{5}$ |
| | $80+\frac{4}{5}+\frac{1}{8}$ |
| | $24\frac{1}{80}+0+\frac{1}{8}$ |

Note, In this *Example* you ſee L. 3 : 4 : 9 made $3\frac{19}{80}$ becauſe the 3 *Pounds* are conſidered as ſo many *Units*; and there are 19 *Three-pences* in 4s. 9d. and 80 *Three-pences* in a *Pound*; and in the former *Example* L. 7 : 8 : 6 was turn'd into $7\frac{17}{40}$; becauſe the 7 *Pounds* are conſider'd as 7 *Units*, and the 8s. 6d. are 17 *Six-pences*, of which 40 are a *Pound*. In *multiplying* this laſt, you ſay thus: 7 *Times* 19 is 133, which are ſo many 80ths of a *Pound*, which reduced is 1 *Pound* $\frac{53}{80}$; then 7 *Times* 3 is 21, and 1 is 22 *Integers* or whole *Numbers*; ſo that the firſt *Product* is $22\frac{11}{80}$, as above; then 8 *Shillings* being no exact *aliquot Part* of a *Pound*, I take 4s. which is $\frac{1}{5}$, and *dividing* by 5, I have $\frac{11}{80}+\frac{4}{5}$ of $\frac{1}{80}$, as above; then I ſet the ſame down again for the other 4s. then I ſay, 6d. is the $\frac{1}{8}$ Part of 4s. and *divide* that *Product* by 8, and there comes out $\frac{6}{80}$ more $\frac{2}{5}$ of $\frac{1}{80}$ more, $\frac{1}{8}$ of $\frac{1}{5}$ of $\frac{1}{80}$ of a *Pound*.

Then adding the ſeveral *Fractions* together, as they ſtand one under another, and the *Total* is $24\frac{3}{80}+\frac{2}{5}+\frac{1}{8}$, that is, 24 *Integers* or *Pounds*, $\frac{1}{80}$ of a Pound,

| | |
|---|---|
| And $\frac{1}{8}$ of $\frac{1}{5}$ of $\frac{1}{80}$ of a *Pound*, that is, | $320\frac{1}{00}$ |
| Now $\frac{1}{80}$ of a *Pound* is equal to | $-\ 3\frac{1}{2}\frac{20}{00}$ |
| So that the *Total* is 24 *Pounds* and | $3\frac{19}{20}$, |

as before.

*Note*, All the *Fractions* beyond the firſt, or that next the whole *Numbers*, are *compounded*, and the beſt Way to read them is backwards, thus: Begin at the *Fraction* next the *Right-hand*, and read towards the *Left-hand*; ſo in the firſt Part

Part of this *Example*, you may read the Total thus, $\frac{1}{2}$ of $\frac{1}{8}$ of $\frac{1}{5}$ of $\frac{1}{40}$ *equal* to - - $\frac{1}{3200}$
then $\frac{1}{8}$ of $\frac{1}{5}$ of $\frac{1}{40}$, *equal* to $\frac{1}{1600}$, or - - $\frac{2}{3200}$
then $\frac{2}{5}$ of $\frac{1}{40}$ equal to $\frac{2}{200}$, equal to - $\frac{16}{3200}$
then $\frac{1}{40}$ is equal to - - - $\frac{32}{3200}$

and the Total is - $\frac{131}{3200}$

And the second Part of this *Example* is read in the same Manner, as you see above.

Or you may do thus:

L. 7 : 8 : 6 Multiplicand.
L. 3 : 4 : 9 Multiplier.

L. 22 : 5 : 6 the Prod. of L. 7 : 8 : 6 multip. by
*f.* *L.* 3
1 : 9 : 8 : 1 + $\frac{1}{4}$ — ditto by 4 s.
0 : 3 : 8 : 2 + $\frac{1}{4}$ — ditto by 6 d.
0 : 1 : 10 : 1 + 0 + $\frac{1}{2}$ ditto by 3 d.

L. 24 : - : 9 : 0 + $\frac{2}{5}$ + $\frac{1}{2}$ or $\frac{2}{10}$ of a *Farthing*.

Or thus:

L. 3 : 4 : 9 Multiplicand.
L. 7 : 8 : 6 Multiplier.

22 : 13 : 3 the Prod. of L. 3 : 4 : 9 mult. by
*f.* *L.* 7
12 : 11 : 1 + $\frac{1}{4}$ dit. by 4 s.
12 : 11 : 1 + $\frac{1}{5}$ dit. by 4
1 : 7 : 1 + $\frac{1}{5}$ + $\frac{1}{8}$ or $\frac{1}{5}$ dit. by 6 d.

24 : — : 9 : 0 + $\frac{2}{5}$ + $\frac{1}{2}$ as before.

Or you may do thus:

L. $7 + \frac{8}{20} + \frac{5}{12}$

By $3 + \frac{4}{20} + \frac{2}{12}$

$22 + \frac{1}{20} + \frac{6}{12}$

$1 + \frac{2}{20} + \frac{8}{12} + \frac{2}{4}$ or $\frac{12}{80}$

$\frac{1}{20} + \frac{6}{12} + \frac{66}{80}$.

$24 + 0 + \frac{4}{12} + \frac{18}{80}$.

Which are thus explained in the firſt Example of the laſt three Methods. I multiply the 6 Pence by 3, ſaying, 3 Times 6 *Pence* is 18 *Pence*, which is 1 *Shilling* and 6 *Pence*; ſet down 6, and carry 1; then 3 Times 8 is 24 and 1 is 25. Now 25 *Shillings* is 1 *Pound* 5 *Shillings*; ſet down 5 and carry 1; then 3 Times 7 is 21, and 1 carried is 22 *Pounds*; ſo that the whole *Product* is 22 *Pounds*, 5 *Shillings*, and 6 *Pence*; but now I am to *multiply* by 4 *Shillings*, which being but the $\frac{1}{4}$ Part of a *Pound*, I divide the 7 *Pounds* by 5, and there remains 2, which is 2 *Pounds*, or 40 *Shillings*, and 8 in the *Multiplicand* make 48; this *divided* by 5, gives 9 and 3 *remains*, which are 3 *Shillings* or 36 *Pence*; and the 6 *Pence* in the *Multiplicand* being *added*, make 42; this divided by 5 gives 8, and 2 *Pence* remains, which are 8 *Farthings*; this divided by 5 gives 1, and $\frac{3}{5}$ of a *Farthing* remains; 9 *Pence* being no exact *aliquot* Part of a *Pound*, or of the 4 *Shillings*, I break it into 2 Parts, *viz.* 6 *Pence* and 3 *Pence*. Now 6 *Pence* is the $\frac{1}{20}$ of a *Pound*, or the $\frac{1}{3}$ of 4 *Shillings*; and the $\frac{1}{3}$ being eaſieſt to work with, I *divide* the Line L. 1 : 9 : 8 : 1 $\frac{3}{5}$, which belongs to the 4 *Shillings*, by 8; thus the 8's in 1 *Pound* is 0; then 1 *Pound* being 20 *Shillings*, this *added* to the 9 makes 29 *Shillings*; and the 8's in 29 are 3 Times, and 5 over, which are 5 *Shillings* or 60 *Pence*, and the 8 *Pence* being added makes 68; this divided by 8 gives 8 *Pence*, and 4 *Pence* remains; which being 16 *Farthings*, and the 1 *added* makes 17, the 8's in which is 2 and 1 *Farthing* left. Now the next Subdiviſion in that Line is $\frac{1}{5}$; ſo that the Farthing is 5 Parts, and which *added* to the 3, makes $\frac{8}{8}$ of a *Farthing*; this *divided* by 8 gives exactly $\frac{1}{8}$ of a *Farthing*: The whole *Product* or *Quotient*

*tient* is 3 s. 8 d. 2 f. $\frac{4}{5}$ for the 6 *Pence*. Now this *multiply'd* by 3 d. which is the $\frac{1}{2}$ of 6 *Pence*, produces 1 s. 10 d. 1 f. and $\frac{1}{10}$ Part of a *Farthing*; for I say, the Half of 3 *Shillings* is 1 *Shilling*, and 1 *Shilling* over, which is 12 *Pence*, and 8 is 20 *Pence*, whose Half is 10 *Pence*; then the Half of 2 *Farthings* is 1 *Farthing*, and the $\frac{1}{2}$ of $\frac{1}{5}$ is $\frac{1}{10}$; so that the several *Products* being collected into one *Sum* make --- L. 24 : — : 9 : 0 + $\frac{4}{5}$ + $\frac{1}{2}$, that is 24 *Pounds* and 9 *Pence* more $\frac{4}{5}$ of a *Farthing*, and $\frac{1}{2}$ of a 5, which made into one *Sum* is $\frac{9}{10}$ of a *Farthing*. The like you may observe of the two under Methods of working the same *Question*.

These Sort of Operations are us'd in nothing so much as in what is commonly called *Cross Multiplication*, or that by which *Painters*, *Plaisterers*, *Joiners*, &c. cast up their Work; and tho' many can perform the *mechanick* Part of such Operations, yet very few know the true Reason of such their Work; therefore you shall have it fully explained here: --- And first the *common* or *vulgar* Method appears by what follows.

*Feet Inches.*

*What is the* Product *of* 9 : 6 multiply'd by 6 : 5? Ans. 60 *Feet* 11 *Inc.* $\frac{1}{2}$

| | |
|---|---|
| Here you first *multiply* | 54 : — |
| the *Feet* by the *Feet*, that is, | 3 : — |
| the 9 by the 6, and the | 3 : 9 |
| *Product* is 54 *Feet*; then | - : 2 $\frac{1}{2}$ |
| you *multiply* the *Inches* by | |
| the *Feet*, that is, the 6 by | 60 : 11 $\frac{1}{2}$ |
| the 6, and the *Product* is | |

36 *Inches*, which *divided* by 12, gives 3 *Feet*; then you *multiply* the 9 *Feet* by the 5 *Inches*, and the *Product* 45 *divide* by 12, and the *Quotient* is 3 *Feet* 9 *Inches*; then you *multiply* the 6 *Inches* by the 5 *Inches*, and the *Product* 30 *divide* by 12, the *Quotient* is 2 *Inches* and $\frac{6}{12}$, or $\frac{1}{2}$; these *added* together make 60 *Feet* 11 *Inches* $\frac{1}{2}$.

Or thus,

| *Feet Inches.* | | *Feet* | |
|---|---|---|---|
| 9 : 6 is the same with $9\frac{1}{2}$ which is $\frac{19}{2}$ | | 77 | 12 |
| 9 : 5 is the same with $6\frac{5}{12}$ which is $\frac{77}{12}$ | | 19 | 2 |
| 24 \| 1463 \| 60 $\frac{23}{24}$ | | 693 | 24 |
| 144 | | 77 | |
| 23 | | 1463 | Numerator. |
| | | 24 | Denominator. |

Here you see the *Product* is 60 *Feet* $\frac{23}{24}$ *Parts* of a *Foot*; and above 'tis 60 *Feet* 11 *Inches*, which is $\frac{11}{12}$ and half an *Inch*, which is $\frac{1}{2}$ of $\frac{1}{12}$, or $\frac{1}{24}$ of a *Foot*: Now $\frac{11}{12}$ of a *Foot* is equal to $\frac{22}{24}$ of a Foot, which *added* to $\frac{1}{24}$ makes $\frac{23}{24}$.

*Note*, In *Measuring*, as well as *Coins*, &c. you cannot properly multiply *Feet* and *Inches* together; but you are to consider the above *Question* in this Manner, *viz.* either as a Piece of *Wainscoting*, *Glazing*, *Pavement*, &c. 9 *Feet* and 6 *Inches*, or half a *Foot*, long, and one Foot broad; and this Breadth is repeated 5 *Times*, and $\frac{1}{12}$ of a *Time*: That is, suppose it *Glazing* Work, which you may imagine to be any Number of *Panes* to make up the whole Height of 9 *Feet* and 6 *Inches*, or $\frac{1}{2}$ a *Foot*, and every Pane one Foot broad; then there would be 6 such *Panes*, and a narrow one of 5 *Inches* broad to make up the whole Breadth; so that there would be in the whole *Window* as much *Glass* as comes to 60 Square *Feet*, and $\frac{23}{24}$ of a *Foot*, to be paid for; though the *Number* of *Panes* be *more* or *fewer*, according to their particular *Heights* and *Breadths*. The same may be said of a Piece of *Pavement* laid with *Marble-squares*, or of *Wainscoting*, &c.

*The last* Example *may be done thus*:

$$\begin{array}{r} 6 : \frac{1}{12} \\ 9 : \frac{1}{2} \\ \hline 57 : \frac{2}{12} \\ 3 : \frac{2}{12} + \frac{1}{2} \\ \hline 60 : \frac{11}{12} + \frac{1}{2} = 60\ \frac{23}{24}. \end{array}$$

Here

Here I do as before in the *Money* Queſtion, and firſt *multiply* 5, the Numerator, by 9, and divide by 12, and the *Quotient* is 3 and $\frac{2}{12}$; then 9 Times 6 is 54, and 3 is 57; ſo that the whole *Product* is $57 + \frac{2}{12}$; then I divide 6 $\frac{1}{12}$ by 2 the Denominator of $\frac{1}{2}$, and $3\frac{1}{12} + \frac{1}{2}$ comes out for the *Quotient* of 6 $\frac{1}{12}$, divided by 2, the ſame with the *Product* of 6 $\frac{1}{12}$ *multiply'd* by $\frac{1}{2}$, the Product of every Multiplication being the *Multiplicand* repeated, ſo many Times as there are *Units* in the *Multiplier*; but every proper or ſimple *Fraction* being leſs than *Unity*, conſequently the *Product* ariſing from ſuch *Multiplication*, muſt bear the ſame Proportion to the *Multiplicand*, as the *Numerator* of ſuch *Multiplier* bears to the *Denominator*, which in this Inſtance happens to be, as 1 to 2, that is, the *Multiplicand* is ſuppoſed to be *multiply'd* by 1, which never makes any Alteration (every Number, whether *whole* or *mix'd*, containing itſelf once) and *divided* by 2; for every whole *Number* is ſuppoſed to have *Unity* for its *Denominator*; and then by the general Rule the *Numerators* are to be *multiply'd* together for a new *Numerator*, and the *Denominators* for a new *Denominator*; and if an improper *Fraction* ariſes, you have already been taught to *divide* the *Numerator* by the *Denominator*. As, ſuppoſe I ſay, *Multiply* 55 by $\frac{1}{5}$; here 'twill be $\frac{55}{5}$ and $\frac{1}{5} = \frac{55}{5} = 11$; ſo that in all Caſes where *Unity* is the *Numerator*, you may *divide* the given *whole*, *mix'd*, or Fractional *Number* by the *Denominator*, and your Work is done. From what has been ſaid, plainly appears the Reaſon of *dividing* by 12, 20, or any other Number, your *Subdiviſions* of *Coin*, *Weight*, *Meaſure*, &c. conſiſt of: As, *Suppoſe I ſay*, *What is the* Product *of* 8 Feet 11 Inches *multiply'd by* 11 Feet? Anſwer 98 *Feet* $\frac{1}{12}$; for the *Queſtion* being put down according to *Art*, 'twill ſtand thus:

*Feet.*

$\frac{8}{1} + \frac{11}{12}$

$\frac{11}{1}$

$\frac{88}{1} + \frac{11}{12}$

Then *multiplying* 11, the *Numerator* of the proper *Fraction* $\frac{11}{12}$, by 11, the *Numerator* of the improper *Fraction* $\frac{11}{1}$, the *Product* is $\frac{121}{12}$, or 10 $\frac{1}{12}$; then $\frac{8}{1}$ by $\frac{11}{1}$ is $\frac{88}{1}$ or 88; to which *add* or *carry* 10 $\frac{1}{12}$, and the whole *Product* is 98 $\frac{1}{12}$; to which *add* the common Appellation or Name, and they are 98 *Feet* and $\frac{1}{12}$ of a *Foot*; which you are to note, are ſuch *Feet* and *Parts*, as the Multiplicand ſtand for or repreſent; which in the Caſe of *meaſuring* all flat Works, ſuch as *Painting*, *Paving*, *Wainſcoting*, *Plaiſtering*, *Carpets*, *Hangings* for Rooms, *Tapeſtry*, &c. is ſuppoſed to be *Yards*, *Ells*, or *Feet* Square, that is,

a *Yard*, *Ell* or *Foot* long and broad. I ſhall now conclude this Head, ſuppoſing myſelf to have ſaid enough to ſatisfy the moſt diffident Perſon.

## *Diviſion of* FRACTIONS.

Here, as in *Multiplication*, you muſt prepare your given *Fractions*, by reducing whole or mix'd Numbers into improper *Fractions*, and compound *Fractions* into ſimple ones, *&c.*

*Then* multiply *the* Numerator *of the* Diviſor *into the* Denominator *of the* Dividend, *for a new* Denominator; *and the* Denominator *of the* Diviſor *into the* Numerator *of the* Dividend, *for a new* Numerator; *which new* Fraction *is the* Anſwer *ſought.*

*Divide* $\frac{1}{2}$ by $\frac{3}{4}$, and the *Quotient* is $\frac{2}{3}$, or 1 and $\frac{1}{3}$. *Demonſtration.* To *divide* any *Number* or *Quantity* by another is the ſame Thing, as to aſk how many Times that *Number* or *Quantity* is contain'd in the other, or what is the *Proportion* between the two: As here, $\frac{3}{4}$ is contained 1 $\frac{1}{3}$ in $\frac{1}{2}$; or $\frac{3}{4}$ is to $\frac{1}{2}$, as 8 is to 9.

*Note*, In the *Quotient* or new *Fraction* ariſing by this Work, the *Denominator* repreſents the *Diviſor*, and the *Numerator* the *Dividend* of the given *Fraction.*

*Divide* $\frac{1}{7}$ of $\frac{1}{2}$ of $\frac{6}{8}$ by $\frac{2}{10}$ of $\frac{11}{12}$ of $\frac{1}{6}$, or $\frac{2}{16}$ by $\frac{11}{80}$, the *Quotient* is $\frac{616}{1760}$, or $\frac{77}{90}$. That is, the *Diviſor* is to the *Dividend* as 77 is to 90.

*Note*, You may abbreviate a compound *Fraction* thus: If any *Number* whatever will divide the *Numerator* of one of the Parts, and the *Denominator* of its correſponding Parts, or any other *Denominator*; you may do it, and work with the remaining *Figures* in the ſame Manner, as if no ſuch *Reduction* was or could be done. As above, $\frac{1}{7}$ of $\frac{1}{2}$ of $\frac{6}{8}$ *reduced* to a ſingle *Fraction*, according to the General Rule is $\frac{6}{112}$; this reduced to its loweſt Terms is $\frac{2}{16}$; but if you reduce $\frac{6}{8}$ to $\frac{3}{4}$, which is in the ſame Proportion, 'twill be $\frac{1}{7}$ of $\frac{1}{2}$ of $\frac{3}{4}$, which is $\frac{2}{16}$; or you may divide the *Denominator* of $\frac{1}{2}$ and the *Numerator* of $\frac{6}{8}$ by 2, and they will be $\frac{1}{1}$ and $\frac{3}{4}$; then the *Sum* will ſtand thus, $\frac{1}{7}$ of $\frac{1}{1}$ of $\frac{3}{4}$, which comes to $\frac{2}{16}$, as before, for the *Dividend*; and $\frac{2}{10}$ of $\frac{11}{12}$ of $\frac{1}{6}$ by the *General Rule*, will be $\frac{22}{720}$, or $\frac{11}{360}$, when *reduced* to its loweſt *Terms*, as is done above. Now $\frac{2}{10}$ of $\frac{11}{12}$ of $\frac{1}{6}$ may be *reduced* to $\frac{1}{10}$ of $\frac{11}{4}$ of $\frac{1}{6}$, by dividing the Numerator 2, and the Denominator 12 by 3; and this again will become $\frac{1}{10}$ of $\frac{11}{4}$ of $\frac{1}{2}$, by *dividing* the *Numerator* of $\frac{1}{10}$, and the *Denominator* of $\frac{1}{6}$ by 3; for then the given Fractions will become $\frac{1}{10}$ of $\frac{11}{4}$ of $\frac{1}{2}$, which *reduced*

*duced* to a ſingle *Fraction*, is $\frac{11}{80}$, as above: Or you may *reduce* the given *Fraction* $\frac{2}{10}$ of $\frac{11}{12}$ of $\frac{1}{8}$ by *dividing* the *Numerator* of $\frac{2}{10}$, and the *Denominator* of $\frac{1}{8}$ by 3, and then they will be $\frac{1}{10}$ of $\frac{11}{12}$ of $\frac{1}{4}$. Now the Numerator of $\frac{1}{10}$ may again be *divided* by 3, and it will become $\frac{1}{10}$, and the Denominator of $\frac{11}{12}$ will become $\frac{11}{4}$; ſo that the *Fraction* is now $\frac{1}{10}$ of $\frac{11}{4}$ of $\frac{1}{3}$, as before; which *reduced* is $\frac{11}{80}$ for the *Diviſor*; and thus you may do upon all Occaſions where compound *Fractions* are concerned; for 'tis much better to have the *Fractions* always in their loweſt *Terms*, tho' the *Anſwer* will be the ſame whether they are or no; but the *Proportion* between the *Numerator* and *Denominator* of the *Anſwer*, cannot be ſo well, nor ſo eaſily determined, when they are in high *Numbers*.

*Divide* $\frac{4}{7}$ by $\frac{11}{14}$, and the *Quotient* is $\frac{56}{91}$ or $\frac{8}{13}$.

That is, $\frac{8}{7}$ is $\frac{8}{13}$ of $\frac{11}{13}$, which is equal to $\frac{104}{143}$, which reduced to its loweſt Terms, is $\frac{8}{11}$, the *Dividend* given.

*Divide* $8\frac{2}{3}$ by 7, and the *Quotient* is $1\frac{5}{21}$:

For $8\frac{2}{3}$ *reduced* is $\frac{26}{3}$, and 7 is $\frac{7}{1}$; theſe diſpoſed rightly ſtand thus, $\frac{7}{1}$ ) $\frac{26}{3}$ ($\frac{26}{21}$ equal to $1\frac{5}{21}$.

*Or you may do thus:*

*Divide* $8\frac{2}{3}$ by 7, by ſaying, the 7's in 8 is 1, and 1 *remains*, which is $\frac{1}{3}$, and theſe added to $\frac{2}{3}$ is $\frac{3}{3}$; the 7's in $\frac{3}{3}$ is 0 Times, and $\frac{1}{7}$ of $\frac{3}{3}$ *remains* equal to $\frac{3}{21}$, as before.

*Divide* $17\frac{3}{5}$ of $\frac{3}{5}$ by $216\frac{2}{8}$ of $\frac{11}{12}$

$17\frac{3}{5}$ $216\frac{11}{16}$

15 16

93 1303

17. 216

263 3463 | 263 ( 2608 *Quotient*

15 16 | 15 51945

3463 163

15 16

17315 978

3463 163

51945 2608

*Note,*

*Note*, When you have prepared your *Fractions*, and ſet them in order for *Diviſion*, if either, or both the *Dividend* and *Diviſor* can be *reduced* lower, 'twill be proper to do it, that the *Quotient* may be in its loweſt *Terms*; but if that can't be done, then you may try if the two *Numerators*, or two *Denominators* of the *Diviſor* and *Dividend* can be *divided* by any common *Meaſure*; and if they can do it, as in the *Example* above, where $\frac{6}{7}$ is *divided* by $\frac{14}{14}$; there the *Fractions* that compoſe the *Dividend* and *Diviſor* are already in their loweſt *Terms*, and therefore nothing can be done with them, conſider'd ſingly; but when they are placed in due Order for *Diviſion*, they will ſtand thus, $\frac{14}{14} | \frac{6}{7}$ (. Here I look, and find that nothing can be done with the *Numerators*, no common *Diviſor* but *Unity* being to be found between 13 and 6; then I try the *Denominators*, and find 7 is a common *Diviſor* to 7 and 14; therefore I *divide* them by 7, and then they will ſtand thus, $\frac{14}{2} | \frac{6}{1}$( Where working, according to the *General Rule*, $\frac{12}{12}$ or $1\ \frac{1}{12}$ comes out. The ſame may be done when there are any other *Figures* or *Numbers* concern'd, whether they be pure *Fractions* or *whole* or *mix'd* Numbers. As,

*Divide* 18 by $\frac{6}{9}$. Here $\frac{6}{9}$ may be made $\frac{2}{3}$; and then $\frac{2}{3} | \frac{18}{1} |$ may be $\frac{1}{3} | \frac{9}{1}$; and this gives $\frac{9}{1}$ or 27 for the *Quotient*, the ſame as if you had work'd with the given *Numbers* unreduced, and then have *reduced* the *Quotient*; as,

$\frac{6}{9} | \frac{18}{1}$ ($\frac{162}{6}$ | or 27; and ſo in any other ſimilar Caſe.

## *The* RULE *of* THREE *in* FRACTIONS.

After the *Queſtion* is ſtated as formerly directed, Page 121, you muſt prepare your ſeveral *Numbers*, as you have been taught in *Multiplication* and *Diviſion* of *Fractions*, viz.

*If any of the given* Numbers *are whole or mix'd* Numbers, *they muſt be* reduc'd *to improper* Fractions; *or if they are compound* Fractions, *they muſt be brought to ſingle ones.*

Then *multiply* the *Numerator* of the firſt Number continually into the *Denominators* of the 2d and 3d Numbers, and the laſt *Product* muſt be the *Denominator* to the fourth *Number* ſought, which is the *Anſwer* to the *Queſtion*, in the ſame *Species* the ſecond *Number* was *propos'd* in, or *reduc'd* to; this done *multiply* the *Denominator* of the firſt *Number* continually into the *Numerators* of the 2d and 3d *Numbers*,

*bers*, and the laſt *Product* muſt be the *Numerator* to the fourth *Number*, which new *Fraction* is the *Anſ.* to the *Queſtion* ſought.

## *EXAMPLE.*

*If* $\frac{1}{4}$ *Yard of* Cambrick *coſt* 5 *s. What will a Piece come to containing* 11 *Yards* $\frac{1}{2}$ *?*

Here, obſerving the Directions above, the *Queſtion* when ſtated, will ſtand thus:

As $\frac{1}{4}$ Yd. is to $\frac{1}{4}$ L. ſo is $\frac{23}{2}$ Yd. to L. $3\frac{1}{6}$, or L. 3 : 16 : 8.

*Note*, If you can *divide* the *Numerator* or *Denominator* of the firſt *Number*, and the *Numerators* or *Denominators* of either the ſecond or third *Numbers*, by any common *Diviſor*, 'tis beſt to do ſo; or you made *divide* the *Numerator* of the ſecond or third *Numbers*, and the *Denominator* of the other, and then the *Anſwer* will be in lower *Terms*, than if you do not ſo abbreviate them, as appears by this *Example*, whoſe *Explanation* follows. Firſt, according to the *Rule*, Page 121, I find that 11 $\frac{1}{2}$ Yards muſt be the third *Number*, becauſe 'tis that which aſks the *Queſtion*; then $\frac{1}{4}$ *Yard* muſt be the firſt *Number*, becauſe 'tis of the ſame general *Species* with that *Number* that aſks the *Queſtion*, viz. *Meaſure*; then of courſe the other *Number*, which is the *Price* or *Value* of the firſt *Number*, muſt ſtand in the ſecond or middle Place, thus:

*If* $\frac{1}{4}$ *Yard coſt* 5 *s. What's the Value of* 11 *Yards and* $\frac{1}{2}$ *?*

The firſt *Number* being already a ſimple *Fraction*, needs nothing to be done to it, and eſpecially as 'tis already in its loweſt Terms, nothing can yet be done with it, in its ſingle *Capacity*; then I conſider that 5 *Shillings* is the $\frac{1}{4}$ of 20 *Shillings*, or the $\frac{1}{4}$ of a *Pound*; and therefore I ſet down $\frac{1}{4}$ inſtead thereof; then the third *Number* being a mix'd *Number*, viz. the whole *Number* 11, and the *Fraction* $\frac{1}{2}$, I bring it into an improper *Fraction*, and 'tis then $\frac{23}{2}$; ſo that the Stating of the whole Work, when ſo prepar'd, will ſtand thus:

| $\frac{1}{4}$ | $\frac{1}{4}$ | $\frac{23}{2}$ |
|---|---|---|
| 23 | 3 | |
| 92 Numerat. | 12 | |
| | 2 | |
| 24 Denomin. | 24 Denomin. | |

Now this wrought according to the general *Rule*, without further *Reduction*, will be as you ſee in the Margin.

Now $\frac{276}{24}$ of a *Pound* is equal to *L.* $3\frac{20}{24}$, which is equal to *L.* 3 : 16 : 8.

But foraſmuch as the



*Denomin-*

*Denominator* 4 of the firſt Number, and the Denominator 4 of the ſecond Number, may both be *divided* by 4; that done, the *Fractions* will then ſtand thus: $\frac{1}{1} - \frac{1}{1} - \frac{23}{2}$; and then working by the general *Rule* above, the *Denominator* of the 4th *Number* will be 6, and the *Numerator* 23, which are $\frac{23}{6}$ of a *Pound*, which is equal to *L.* $3\frac{5}{6}$ or L. 3 : 16 : 8, the ſame with the other, only in lower Terms.

You may proceed in the ſame Manner, upon all other Occaſions, and work even all the common Queſtions that are wrought by the former Methods, contain'd from Page 120 to Page 130; for in reality, all that is done there is virtually, tho' not actually doing what is here taught; as ſhall appear plainly, by working ſome of thoſe Queſtions over again, here, by the Method now taught.

Page 121, the Queſtion there is, *If one Yard of Cloth coſt 6 Pence, What coſt 8 Yards?*

This prepared according to the Directions given in this Rule, will ſtand thus:

$\frac{1}{1} - \frac{1}{40} - \frac{8}{1}$
Or reduc'd
$\frac{1}{1} - \frac{1}{5} - \frac{1}{1}$
which comes out $\frac{8}{5}$

Here I ſubſtitute *Unity* or 1, for the *Denominators* to the whole *Numbers*, 1 *Yard* and 8 *Yards*; then I conſider that 6 *Pence* is the $\frac{1}{40}$ of 20 *Shillings* or a *Pound Sterling*; all which being prepared, will ſtand as in the firſt Line above; then in order to abbreviate the given *Fractions*, ſee that the *Denominator* of the middle Number $\frac{1}{40}$, and the Numerator of the third Number $\frac{8}{1}$, may both be divided by 8, which I do, and when ſo reduced they will ſtand as in the ſecond Line above. Now here no poſſible Reduction can be further made, and therefore I multiply the Numerator of the firſt Number or Fraction $\frac{1}{1}$ into the Denominators of the ſecond $\frac{1}{5}$, and third $\frac{1}{1}$, and the Product is 5, for a Denominator to the fourth Number ſought; then I multiply the Denominator of the firſt Fraction into the Numerators of the ſecond and third Fractions, and that Product is only Unity, or 1, for the Numerator of the fourth Number ſought, which ſo compleated is $\frac{1}{5}$; and to know the Name of the Species to be apply'd to this $\frac{1}{5}$, I look and ſee what the ſecond or middle Number $\frac{1}{40}$ was call'd, and find twas called $\frac{1}{40}$ of a Pound *Sterling*; therefore I call the Number or Fraction now found out the $\frac{1}{5}$ of a Pound *Sterling*, which by the Rule, Page 142, comes to 4 Shillings; the ſame as you ſee in Page 121.

Again,

Again, the ſecond Queſtion, Page 121, is, *If a Sack of Malt, Quantity* 4 *Buſhels, coſt* 12 *s.* 6 *d. What comes* 85 *Buſhels to?* This reduced to Fractions will ſtand thus:

$\frac{4}{1} — \frac{1}{8} — \frac{85}{1}$.

Now theſe cannot be *reduced* any lower, becauſe no *Number* but *Unity* can *divide* the *Numerator* of $\frac{4}{1}$, and the *Numerators* of either $\frac{1}{8}$ or $\frac{85}{1}$; and ſo 'tis likewiſe impoſſible to abbreviate the *Denominators*, as 'tis alſo to *reduce* the *Numerator* of the ſecond, and the *Denominator* of the third, or the *Numerator* of the third, and the *Denominator* of the ſecond; and therefore the Work muſt be performed by the general *Rule*, and the *Amount* will be $\frac{340}{32}$ of a *Pound* Sterling, or *L.* 13 $\frac{20}{32}$, equal to *L.* 13 : 5 : 7 $\frac{1}{2}$.

Again, the 3d *Queſtion*, Page 125, is, *Suppoſe I buy a* Bale *of Linen Cloth, Quantity* 58 *Pieces, each Piece* 29 Ells Engliſh, *at* 15 *d.* $\frac{1}{2}$ *per* Yard, *What is the Whole worth, and how much do I gain per* Cent. *if I ſell it at* 21 *d. per* Ell Engliſh?

As there are various *Methods* of doing ſuch like *Queſtions*, we will here purſue one different from that in Page 126, on purpoſe to ſhew the *Harmony* and Agreement of all the different Proceſſes in this *Art*.

That Part of the *Queſtion* that aſks, what is the Whole worth, may be applied to the buying or ſelling *Price*; but 'tis moſt natural to mean the latter, for the *Queſtion* of *Profit* per *Cent.* may be anſwer'd without finding the whole *Worth* or *Coſt*, at the buying *Price*, as appears by the following Work.

*If* $\frac{4}{1}$ Ell Eng. *coſt* 15 *d.* $\frac{1}{2}$, *What coſt* $\frac{1}{1}$ Ell Engliſh?

21 Sold for

$\frac{21}{2}$ Anſ. $1\frac{5}{8}$ d. or 19 $\frac{1}{8}$ Bought for

*per* Ell 1 $\frac{1}{8}$ gain'd.

*If* 19 *d.* $\frac{1}{8}$ *gain* 1 *d.* $\frac{1}{8}$, *What* 100 *L.* or $\frac{24000}{1}$ *gain?*

$\frac{152}{8} — \frac{1}{8}$ ——— $\frac{24000}{1}$

reduced, twill be

$\frac{152}{1} — \frac{1}{1}$ ——— $\frac{24000}{1}$

Theſe reduced again, will be $\frac{21}{1} — \frac{1}{1} — \frac{4800}{1}$. Theſe multiply'd by the Rule produces $\frac{4824000}{1}$ or 2012 *Pence* $\frac{48}{51}$ which is *L.* 8 : 7 : 8 : 3 and $\frac{12}{51}$ of a *Farthing*.

So that the Gain per *Cent.* or by laying out L. 100 will be L. 8 : 7 : 8 : 3 and $\frac{12}{31}$ Parts of a Farthing.

And here I am to take Notice of a Miſtake in *Page* 126, where L. 143 : 3 : 6 is ſet down and work'd with, inſtead of L. 147 : 3 : 6; and therefore the *Anſwer* there is falſe, although the Work is right, owing to the ſaid Miſtake; and therefore 'tis repeated here again, as it ought to be, *viz.*

*If* L. 135 : 15 : 8 $\frac{1}{4}$ *the Money the whole coſt give* L. 147 : 3 : 6, *the Money the whole was ſold for, What will* L. 100 *give?*
Theſe Num. reduced, will be 40

130355 Farthings — 5887 Sixpences 96000 *Far.*
96000 Farthings in L. 100.

353220000
52983

130355) 565152000 (4335
521420

437320
391065

462550
391065

714850
651775

63075 Parts of Sixpence.
6

378450
260710

117740 Parts of a Penny.
4

470960
391065

Remains 79895 Parts of a Farthing.
130355

So

So that it appears, the Amount of L. 100 will be L. 108 : 7 : 8 : 3, that is, the Gain is L. 8 : 7 : 8 $\frac{1}{4}$ and $\frac{12}{13}\frac{8}{0}\frac{2}{3}\frac{1}{1}$ Parts of a Farthing, which reduced, will come to $\frac{12}{37}$ Parts, as above. By which it appears, that uſe what *Method* you pleaſe, if the Work be right, the *Reſults* will be always the ſame. I preſume enough has been ſaid to make the whole Doctrine of *vulgar Fractions* ſufficiently plain, and therefore I will now proceed to explain the Nature, Uſe, and Advantage of *Decimal Fractions*, commonly call'd ſimply *Decimals*, becauſe they are wrought as whole *Numbers* without regarding their *Denominators*.

## CHAP. VII.

*Contains the General Definition of* DECIMALS, *and explains the Methods of uſing them, in the ſeveral Rules or Operations of* Addition, Subſtraction, Multiplication *and* Diviſion.

### *DEFINITION.*

COmputation by *Decimals* is called *Artificial-Arithmetick*, becauſe it ſubſtitutes an artificial fractional Number in the room or ſtead of a true and natural one, to repreſent the Part or Parts of any whole Thing; and theſe are ſometimes perfectly *exact*, and at other times only nearly *true*. The Name *Decimals* is given to it, becauſe all the *Parts* of any whole *Number* whatever is expreſs'd or ſet down in *Tenths*, *Hundreds*, *Thouſands*, &c. always going on by a *Tenfold* or *decuple* Proportion; and all theſe Fractions have for their *Denominator* an *Unit*, with ſo many *Cyphers* annexed to them, as there are *Figures* in the given *Decimal*, which is the *Numerator* to the ſaid *Denominator*; and becauſe the *Denominator* is always known and fix'd, therefore 'tis ſeldom or never ſet down; but the whole Proceſs is in every reſpect wrought as whole *Numbers*; only to diſtinguiſh the *Parts*, from the whole *Numbers*, a Comma, or *Mark* of Diſtinction is made between that Part of any given *Number* that repreſents the whole *Number*, and that Part which repreſents the *Fractional Parts*, where you are always to obſerve, that whole *Numbers*, when mix'd with or join'd to *Decimal Parts*, always ſtand on the

*Left-hand* of the *Comma* or *Mark* of Diſtinction, and the *Decimals* on the *Right-hand* as follows; where theſe *Figures* 675 may repreſent ſo many whole *Numbers*, or 67 whole *Numbers* and 5 *Parts*, which is $\frac{5}{10}$ of a whole Number; ſo that together it is 67 $\frac{1}{2}$, or it may ſtand for 6 whole *Numbers* and 75 *Parts*, or $\frac{75}{100}$ of a whole Number, which is 6 $\frac{3}{4}$; or it may ſtand for 675 *Parts* only, that is, $\frac{675}{1000}$ of a whole Number, which is $\frac{27}{40}$. In all theſe Caſes they are diſtinguiſhed thus: 675, without any Mark, ſtands for whole *Numbers*; but 67,5, in the ſecond Caſe above, repreſents 67 whole *Numbers*, and $\frac{1}{2}$; and 6,75, in the third Caſe above, repreſents only 6 whole *Numbers*, and $\frac{3}{4}$; and ,675, only repreſents $\frac{675}{1000}$ which is $\frac{27}{40}$ of a whole *Number*: And if you put one or more *Cyphers* on the *Left-hand* of the ſignificant *Figures*, it increaſes the *Denominator* Ten, a Hundred, a Thouſand, *&c. Times*, and conſequently decreaſes the given *Decimal* to a *Tenth*, an *Hundredth*, a *Thouſandth*, &c. Part of what it ſtood for without ſuch added *Cypher* or *Cyphers*, as the ,675 or $\frac{27}{40}$ above, of any whole Thing, becomes $\frac{27}{400}$, by making it ,0675, and $\frac{27}{4000}$, by making it ,00675 and $\frac{27}{40.000}$ by making it ,000675; and the like is to be obſerved of any other *Decimal Number*, as, ,5 is $\frac{1}{2}$, ,05 is $\frac{1}{20}$ ,005 is $\frac{1}{200}$, ſo ,0005 is $\frac{1}{2000}$, *&c.*

The Agreement between whole *Numbers* and *Decimals*, are fully expreſſed by the following *Table.*

*The* Notation *and* Numeration *of* Whole Numbers. —— Decimals.

| C | X | | C | X | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Millions* | *Millions* | *Millions* | *Thouſands* | *Thouſands* | *Thouſands* | *Hundreds* | *Tens* | *Units* | —— | *Tenths of Unity, or Primes* | *Hundredths or Seconds* | *Thouſandths or Thirds* | *Thouſandths or Fourths* | *Thouſandths or Fifths* | *Millionths or Sixths* | *Millionths or Sevenths* | *Millionths or Eighths* | *Thouſandths Millionths or Ninths, &c.* |
| 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | —— | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |

Here you are to obſerve that as in whole *Numbers*, the Figures of every compound *Number* increaſe their Value ten *Times*, every Place or Remove they are diſtant from *Unity*,

*Unity*, towards the *Left-hand*; but in *Decimals* they decreaſe their Value ten *Times*, by the Number of Places they are diſtant from Unity, which here is juſt the Reverſe to whole *Numbers*, being computed towards the *Right-hand*. Now the *Figures*, 9, 8, 7, 6, 5, &c. above, may both ſtand for abſolute *Numbers* or Parts of *Numbers*; and alſo, as *Indexes* to ſhew or expreſs the *Place* or *Value* of any *Figure* ſtanding there: As for Inſtance, in whole *Numbers* the *Figure* 3, may ſignify the 3d *Order* or *Degree*, which is *Hundreds*; and it may alſo expreſs ſo many *Hundreds*; but in the contrary Scale the 3 repreſents *Thirds*, or three *Thouſand* Parts of *Unity*, as was above taught; becauſe the 1 or Place of *Primes* expreſſes ſo many *tenth* Parts of *Unity*, as the ſingle *Figure* ſtands for; as, if 'tis 1, then 'tis ,1 or $\frac{1}{10}$; if ,2 'tis $\frac{2}{10}$; if ,3, 'tis $\frac{3}{10}$, &c. So in *Second*'s Place ,01 is $\frac{1}{100}$, 02 is $\frac{2}{100}$ ,03, is $\frac{3}{100}$ ,07, is $\frac{7}{100}$, &c. So in the *Third*'s Place ,001 is $\frac{1}{1000}$ ,002 is $\frac{2}{1000}$ ,009 is $\frac{9}{1000}$, &c. only you are to obſerve, that if you would expreſs only the *Figure* or *Parts* repreſented by the 2, 3, 4, 5, &c. Place, *viz.* 1, 2, 3, 4, &c. *Hundredths*, *Thouſandths*, *ten Thouſandths*; you muſt ſupply all the vacant Places towards the *Left-hand*, &c. with *Cyphers* or 0's. As, ſuppoſe I was to ſay, ſet down 8 *ten Thouſandths* of *Unity*; here I look in the *Table*, and find the *fourth* Place is the *ten Thouſandths* of *Unity*, and therefore I firſt write down the required Number 8, and then towards the *Left-hand*, write 3 *Cyphers* or 0's thus, 0008, before which, towards the *Left-hand*, next to the firſt 0, I make a *Comma*, and then they will ſtand thus, ,0008; the Uſe of the *Comma* is, to ſhew the *Number* ſo expreſſed is a *Fractional* Part of *Unity*; but without that, or ſome other diſtinguiſhing Character, they would ſtand abſolutely for 8 *Units*, becauſe *Cyphers* on the Left-hand of whole *Numbers*, neither add to, nor diminiſh from their true Value.

If ſeveral *Figures* are ſet down for a *Decimal*, they repreſent the *Aggregate* or *Total* of ſo many diſtinct *Decimals* as there are Places in the given Figures, as, ,123 ſtand for *one Hundred* and *twenty three thouſandth Parts* of *Unity*, that is, the 1 is one *Prime*, or $\frac{1}{10}$ Part of *Unity*, the 2, is two *Seconds*, or $\frac{2}{100}$ Parts of *Unity*, and the 3, is three *Thirds* or $\frac{3}{1000}$ Parts of *Unity*.

Now $\frac{1}{10}$ is equal to $\frac{100}{1000}$, and $\frac{2}{100}$ is equal to $\frac{20}{1000}$; and theſe added to $\frac{3}{1000}$, will make $\frac{123}{1000}$; but, as has been already obſerv'd, the *Denominator* of every *decimal Fraction*, being *Unity*, with ſo many *Cyphers* annexed, as there are *Figures* in the

the given *Decimal*, the *Denominators* are ſeldom or never ſet down, unleſs it be purely for the ſake of *demonſtrating* the Truth of any *Propoſitions*, or explaining the Nature of *Decimals*, &c. as above. From what has been ſaid, 'twill be natural to conclude, you now know how to expreſs the Value of any given *Decimal*, whether great or ſmall; as of ,2 of ,02, of ,202, of ,0056, of ,470096, *&c.* the ſame *Law* or *Rule* being always to be obſerved in every *Decimal*, whether conſiſting of many or few *Figures*, viz. that you *number* the given *Decimals* as if they were whole *Numbers*, and then imagine a *Denominator* to be ſubſcribed to the given *Figures*, which are always ſuppoſed to be the *Numerator* to ſuch *Denominator*, that conſiſts of an *Unit*, with ſo many *Cyphers* annexed, as there are *Figures* in the given *Decimal*; as in the Examples above.

,2 is $\frac{2}{10}$ or two *Tenths* ,02 is $\frac{2}{100}$, or two *Hundredths*, ,202 is $\frac{202}{1000}$ or *two Hundred and two Thouſandths*; ,0056, is $\frac{56}{10000}$, or *fifty ſix ten Thouſandths*; ,70096 is $\frac{70096}{100000}$ is *ſeventy Thouſand* and 96 *one Hundred Thouſandths*, &c.

The next Buſineſs will be to ſhew you how Decimals are generated, for the true and eaſy uunderſtanding whereof you are to conſider that every Number is immediately called or underſtood to be an abſolute Number, repreſenting ſome one whole Thing, or an Aggregate of ſeveral or many whole Things, or elſe is a Part or Parts of ſome other Number that repreſents ſome whole Thing; and theſe are as infinitely various, as the Figures they are, or may be repreſented by ; and when expreſſed in its full Perfection, always conſiſts of two Parts; the one called a Numerator, and the other the Denominator, as was taught you very fully in the laſt Chapter, with the ſeveral Ways of managing ſuch Parts or Fractions; but here, only one Part, or the Numerator, being only us'd, we ſhall now teach you how

*To change, reduce, or convert Vulgar* Fractions *into* Decimals.

*Firſt*, If the given Fraction be a ſimple one, add any Number of Cyphers to the Numerator, and then divide the Numerator, with the Cyphers ſo added by the Denominator, till 0 remains; but if after dividing 4, or 5 Times, ſomething ſtill remains, you may ceaſe, and reckon the Quotient of ſuch Diviſion for the Decimal, rejecting the Remain-

Remainder, as being of too ſmall a Value to be of any Significancy: As for Inſtance,

*What is the* Decimal *to* $\frac{1}{4}$? Anſwer ,75.

Here I ſet down the 3, and annex 2 Cyphers to it, and then divide by 4 thus:

4 | 300
——— and after two Diviſions, I have
,75

,75 in the Quotient, and 0 remains; therefore, I ſay, ,75 is the Decimal to $\frac{1}{4}$ of Unity, which, if you want it for any particular Uſe, you may call $\frac{1}{4}$ of a Ton, of a Pound, of a Yard, of an Hour, &c. So if I aſk, *What is the Decimal to* $\frac{2}{3}$? Here I do the ſame, and find the Anſwer to be ,66666, &c.

Again, If I aſk what is the Decimal to $\frac{17}{68}$? I find the Anſwer to be ,25, as you may ſee by the following Work.

68 | 1700 (,25
136
———
340
340
———
00
———

*and the Decimal to* $\frac{7}{38}\frac{14}{42}$ is

3842) 275600000 (,71733, &c.
26894
———
6660
3842
———
28180
26894
———
12860
11526
———
13340
11526
———
1814

*Note*, So many *Cyphers* as you *add* to the *Numerator*, ſo many *Places* or *Figures* muſt be in your *Decimal*, as you ſee in the four *Examples* above, where, in the *firſt Example* two *Cyphers* only are *added* to the *Figure* 3; and the *Decimal* conſiſts accordingly of 2 *Figures*, *viz.* ,75; but five *Cyphers* being *added* to the ſecond *Example*, and the *Diviſion* being made, there comes out, ,66666, and the *Remainder* is 2, which is rejected upon

account of the Smallneſs of its *Value*, as ſhall be ſhewn by and by: In the 3d *Example* only 2 0's are *added*, and the *Quotient* is ,25, and 0 *remains*; in the 4th *Example* 5 *Cyphers* are *added*, and after the *Diviſion* is made, 1814 *remains*, and the *Quotient* is ,71733, for the *Decimal*.

But it may ſo happen, and that very often too, that the *Quotient* may not have ſo many *Figures* as you was obliged to add *Cyphers* to the *Numerator*; in that Caſe you muſt *add* as many *Cyphers* on the *Left-hand* of the *Quotient*, as is the Difference between the *Number* of *Figures* in the *Quotient*, and the *Number* of *Cyphers* added to the *Numerator*; as, *What is the Decimal to* $\frac{300000000}{6181}$ ?

```
6181) 300000000 (,00048519
      24724
      -----
       52760
       49448
       -----
        32120
        30905
        -----
         12150
          6181
          ----
           59690
           55629
           -----
            4061
```

Here, before I can have a ſignificant *Figure* in the *Quotient*, I muſt *add* 4 *Cyphers* to the *Numerator*; and therefore I muſt add 3 *Cyphers* towards the *Left-hand*, to make up that 1 *Figure* 4 Places; and then go on as before.

*What is the Decimal to* $\frac{1}{25}$ ? *Anſwer* ,04.

```
25 | 100 (,04
     100
     ---
      00
      --
```

And ſo in all other Caſes, whether your given *Number* or *Decimal* found conſiſt of few or many *Figures*.

*Note*, After you have carried your *Decimal* to 4, 5, or 6 Places, and the *Remainder* is of any conſiderable Value, you may continue *dividing* by *adding* 1 or more *Cyphers* to the *Numerator*, and the *Quotient* will be increaſed by 1

or more *Figures*; and tho' the Remainder ſhould continue the ſame in *Figures*, yet the Value of it will be but $\frac{1}{10}$, $\frac{1}{100}$, $\frac{1}{1000}$, *&c.* Part of what it was before, according as you increaſe the *Number* of Places in the *Decimal*; as you may ſee by finding the *Decimal* to $\frac{1}{12}$ which is found to be ,083333, *&c.* For if the *Decimal* had been carried on to but three *Places*, viz. ,083, the *Remainder* would then be $\frac{1}{3}$ of $\frac{1}{1000}$, or $\frac{1}{3000}$ of *Unity*; but making it ,0833, 'tis then but $\frac{1}{4}$ of $\frac{1}{10000}$, or $\frac{1}{30000}$; ſo when 'tis ,08333, then the *Remainder* is but $\frac{1}{120000}$; and when 'tis ,083333, 'tis then but $\frac{1}{360000}$, and ſo on; from whence 'tis eaſy to obſerve, that according to the Uſe the *Decimal* is to be apply'd to, it may be proper to make it conſiſt of more or fewer *Figures*, when they are *interminate*, that is, either have the ſame ſingle *Figure* conſtantly remaining, or a certain *periodical* Number of *Figures* remaining; for 'tis the Property of ſome *Decimals* to *terminate*, and have no *Remainders*, as is the Caſe of all aliquot Parts of 10, 100, 1000, 10000, 100000, *&c.* theſe are called perfect *Decimals*; and 'tis the Property of others to have one conſtant *Figure* remaining continually; as, when you require the *Decimal* of $\frac{1}{3}$: Here the *Quotient* or *Decimal* will be always 3's, and the *Remainders* 1's, and if you wanted the *Decimal* of $\frac{2}{3}$, the *Quotient* will be always 6's and the *Remainders* 2's. So again, if you aſk'd for the *Decimal* to $\frac{1}{9}$, the *Anſwer* will be as many ,1's as you pleaſe, and the *Remainders* will be alſo 1's, and $\frac{2}{9}$ the *Decimal* will be always 2's, and the *Remainders* 2. So $\frac{4}{9}$ will have always 4's both for the *Decimal* and *Remainders*, $\frac{5}{9}$ will be always 5's, *&c.* Other *Decimals* there are that go on 1, 2, 3, 4, 5, 6, *&c. Figures*, before they fall into this ſingle continual *Repetition*. As, $\frac{1}{14}$ begins at the 2d *Figure*, being ,0666, *&c.* ſo $\frac{2}{14}$ is ,1333, *&c.* $\frac{4}{14}$, is ,2666, *&c.* and $\frac{1}{12}$ begins at the 3d Figure, the two firſt being ,08 and all the reſt are 3's, and $\frac{1}{12}$ is ,416666, *&c.* beginning likewiſe at the 3d Figure with 6's, *&c.* Others there are that continually repeat 2 Figures, even from the Beginning, as $\frac{1}{11}$ is ,090909, *&c.* ſo $\frac{2}{11}$ is ,181818, *&c.* and $\frac{3}{11}$ is ,272727, *&c.* $\frac{4}{11}$ is ,363636, *&c.* Others begin at the 2d Figure, and repeat 2 Figures; as $\frac{1}{22}$ is ,0454545, *&c.* likewiſe $\frac{7}{22}$ is ,31818, *&c.* Others go to 3, 4, 5, 6, *&c.* Places; and then repeat the whole again, as $\frac{1}{7}$ is ,142857,14, *&c.* $\frac{2}{7}$ is ,285714,285, *&c.* $\frac{1}{13}$ is ,076923076923, *&c.* So $\frac{6}{13}$ is ,461538461538, ,46513, *&c.* to Infinity. Others there are that only approximate, and never cir-

culate, as $\frac{6}{37}$ is ,724137931034482, &c. So $\frac{23}{37}$ is ,6761006289, &c. Now thoſe that circulate in any of the Manners above, may be commodiouſly wrought with in the various Operations of *Addition*, *Subſtraction*, *Multiplication*, and *Diviſion*, as correctly as if they were abſolutely *perfect* and *terminate*; and the ſeveral *Totals*, *Differences*, *Products*, and *Quotients*, will be alſo *circulating Decimals*; but thoſe that neither *terminate* nor *circulate*, viz. thoſe called *Approximates*, muſt be proportion'd, as has already been taught, Page 169, and ſhall hereafter be further explained in order to leſſen the *Error* that will neceſſarily ariſe by working with them.

*Secondly*, If the given *Fraction* is a *compound* one, *reduce* it to a *ſimple one*; and then work as above.

## *EXAMPLE.*

*What is the Decimal to* $\frac{5}{7}$ *of* $\frac{4}{5}$ *of* $\frac{3}{4}$? This reduced to a ſimple *Fraction*, is $\frac{60}{224}$, the *Decimal* whereof is ,40178. Again,

*What is the* Decimal *to* $\frac{1}{2}$ *of* $\frac{7}{10}$ *of* $\frac{4}{15}$ *of* $2\frac{2}{34}$? *Anſwer* ,002834. Here the *compound Fraction*, when *reduced* to a *ſingle* one is, $\frac{238}{83920}$, which requires 3 *Cyphers* to be *added* to its *Numerator*, before there will be one ſignificant *Figure* in the *Quotient*; ſo that there muſt be 2 *Cyphers* added on the *Left-hand*, as you ſee done in the *Example* above.

Likewiſe when a *compound Fraction* is given, inſtead of reducing it to a ſimple *Fraction*, firſt you may find the *Decimal* to any one of the Parts, and then take the other Parts of that *Decimal*, and 'twill come to the ſame Thing. As,

*What is the Decimal to* $\frac{1}{2}$ *of* $\frac{3}{4}$ *of* $\frac{7}{8}$?

Here I find the *Decimal* to $\frac{7}{8}$ to be - ,875 then
I find the $\frac{1}{4}$ of this to be - - - ,65625 and
I find the $\frac{1}{2}$ of this to be - - - ,328125
which laſt is the true *Decimal* ſought. Again,
I find the *Decimal* of $\frac{1}{2}$ to be - - - ,5
the $\frac{1}{4}$ of which is - - - - - ,375
the $\frac{7}{8}$ of which is - - - ,328125
the ſame as before.
Or the *Decimal* of $\frac{3}{4}$ is - - - ,75
the $\frac{7}{8}$ of which is - - - ,65625
the $\frac{1}{2}$ of which is - - - - ,328125.

Now

Now this given *compound Fraction* reduced to a ſingle *one*, is equal to $\frac{21}{64}$, which reduc'd to a *Decimal*, gives 328125, as before.

So that work which Way you pleaſe, the *Reſult* or *Anſwer* is always the ſame, if the Work be truly perform'd.

*Thirdly*, If the given *Fraction* be an *improper* one, *reduce* it to a whole or mix'd *Number*, and if it ſhall ſo happen that there comes out a whole *Number*, by the *Reduction*, there can be no *Decimal*, becauſe a *Decimal* always repreſents a *Part* or *Parts* of ſome whole *Thing*, and can never repreſent the whole Thing it ſelf; but if after the *Reduction* is made, the given improper *Fraction* becomes a mix'd *Number*, then you may let alone the whole *Part*, and work with the *Fractional Part*, as has already been taught you.

## EXAMPLE.

*What is the Decimal to* $\frac{27}{3}$?

Here upon *reducing*, I find 9 whole *Numbers*; conſequently there can be no *Decimal*, but only 9 whole Somethings, whether it be Coin, Weight, Meaſure, *&c.* Again,

*What is the Decimal to* $\frac{37}{5}$? *Anſw.* 5,4.

Here upon *reducing*, I find 5 and $\frac{2}{5}$, I work with the $\frac{2}{5}$, and find ,4 to be the *Decimal*, to which I add the 5 whole *Numbers*, and they ſtand thus 5,4, that is, 5 whole Things, and ,4 *Tenths* of another whole *Thing*: and thus you muſt proceed continually; for all the various *Caſes* that can happen, are included in *one* of the *three* above mentioned.

*Note*, 'Twill be the ſame Thing whether you reduce an improper *Fraction* to its whole or mix'd *Number*, before you go about to find the whole *Part* and the *Decimal Part*, or divide the *Numerator* of the improper *Fraction* by the *Denominator*, adding ſo many *Cyphers* to the *Numerator*, as occaſion may require; for in all ſuch Caſes there muſt be cut or parted off from the *Quotient* towards the *Right-hand*, ſo many *Figures* for the *Decimal Part*, as you added *Cyphers* to the *Numerator*; and the remaining *Figures* on the *Left-hand*, are whole *Numbers*. As in the Examples following.

*What whole Number and Decimal Parts are equal to* $\frac{578}{24}$?

24) 578,000000 (24,083333, *&c.*

the *Remainder* being in this *Example* always 8, if you continue the Work ever ſo long. So that 24 is the whole *Number*, and ,083333 the *Decimal Part*, which is the ſame as if you had *reduced* it firſt; for 578, *divided* by 24, gives $24\ \frac{2}{24}$, or $24\ \frac{1}{12}$. Now the *Decimal* to $\frac{1}{12}$ is ,083333 and

$\frac{4}{12}$

$\frac{4}{12}$ or $\frac{1}{3}$ *remains*, which is the ſame with the other; for $\frac{4}{24}$ is equal to $\frac{4}{12}$ or $\frac{1}{3}$. The like may be obſerv'd in all other Caſes.

*To reduce any Part or Parts of* Money, Weight, Meaſure, *&c. to a* Decimal.

Here you muſt conſider what is, or may be your *Integer*, and order your *Subdiviſions* accordingly, in the Form of a *compound Fraction*; and then work as before directed.

## *EXAMPLE.*

*What is the* Decimal *to* 13 *Shillings*, *a Pound being the Integer?*

Here 13 *Shillings* is the $\frac{13}{20}$ of a *Pound*, the *Decimal* to which is ,65; for adding 2 *Cyphers* to 13, the *Numerator*, and dividing by 20, the *Denominator*, the *Quotient* is 65, and 0 *remains*.

*What is the* Decimal *to* 9 *Pence*, *a Pound being the Integer?*

Here 9 *Pence* is the $\frac{9}{12}$ of the $\frac{1}{20}$, which is the $\frac{9}{240}$ of a *Pound*, the *Decimal* whereof is ,0375.

*What is the* Decimal *to* 3 Farthings, *a* Pound *being the Integer?*

Here 3 *Farthings* is the $\frac{3}{4}$ of $\frac{1}{12}$ of $\frac{1}{20}$, which is the $\frac{3}{960}$ or $\frac{1}{320}$ of a *Pound*, whoſe *Decimal* is ,003125.

*What is the* Decimal *to* 15 Pounds, *an hundred Weight*, *or* C. *being the Integer?*

Here 15 *Pounds* Weight is the $\frac{15}{112}$ of C. whoſe *Decimal* is ,1339, *&c.*

*What is the* Decimal *to* 5 *Ounces*, C. *being the Integer?*

Here 5 *Ounces* is the $\frac{5}{16}$ of $\frac{1}{112}$, which is the $\frac{5}{1792}$ of C. whoſe *Decimal* is ,00279, *&c.*

*What is the* Decimal *to* 13 s. 5 d. $\frac{1}{2}$, *a Pound being the Integer?*

Here, and in all ſuch like Caſes 'twill be beſt to reduce the given *Sum* or *Number* into the loweſt Name; as here, into *Farthings* or *Half-pence*, thus: 13 : 5 $\frac{1}{2}$

24 *Halfpence* in a *Shilling*.

52

26.

11 *Half-pence* in 5 d. $\frac{1}{2}$

the *Half-pence* in 13 : 5 $\frac{1}{2}$ is 323 for the *Numerator*.

the *Half-pence* in a *L.* Sterl. is 480 for the *Denominator*.

480)

480) 3230000 (,6729 the *Decimal* sought. The *Remainder* 180, being leſs than half the *Diviſor*, viz. $\frac{1}{8}$, you may reject it upon account of the Smallneſs of its Value, being but $\frac{1}{800}$ of a L. *Sterling*, or the $\frac{2}{240}$ of a *Farthing*.

2880

3500
3360

1400
960

4400
4320

180

*Days Hours Min.*

*What is the* Decimal *of* 17 : 13 : 25, *a Year of* 365 *Days, being the Integer?*

24

1460
730

8760
60

Min. 525600 in a Year of 365 Days

17 : 13 : 25
24 *Hours* in a *Day*.

71
35

*Days Hours.*

421 *Hours* in 17 and 13
60 *Minutes* in an *Hour*.

25285 *Minutes* in all.

5256|00|252850000|00(,048106 the *Dec.* requir'd
21024 . . . .

42610
42048

5620
5256

36400
31536

4864 remains.

*Note*,

*Note*, If the *Remainder* is equal to $\frac{1}{2}$ or more of the *Diviſor*, you may make the laſt *Figure* of the *Quotient* 1 more than it naturally comes to: As here the *Remainder* is more than $\frac{1}{2}$ the *Diviſor*, ſo that you may make the 6 a 7, and the *Decimal* will then be ,048107, which is nearer the Truth than the other, being but $\frac{49}{637000000}$ of a Year too much; whereas ,048106 is $\frac{608}{637000000}$ of a *Year* too little.

*To find the Value of a* Decimal *in the known Parts of* Coin, Weight, Meaſure, *&c.*

## RULE.

*Multiply* the given *Decimal* by the Number of Parts of the firſt *Subdiviſion* of the given *Integer*; and if the *Product* comes to more *Figures* than is the Number of thoſe given, cut off the Surplus *Figures* towards the *Left-hand*, and they will be the *Anſwer* in that Part of *Coin*, *Weight*, &c. as *anſwers* to that *Subdiviſion*; and if there are any Figures left, you may do the like by them; and ſo continue *multiplying* the remaining *Figures* by the Number of Parts in the next inferior *Denomination*, either till the *Product* of the *Decimal* comes to all 0's, or that you have gone through all the *Subdiviſions* commonly us'd or known, always cutting off the Surplus *Figures*, as you ſee done in the following

## *EXAMPLES.*

*What is the Value of* ,75 *of a Pound* Sterling?

20

15,00 *Anſ.* 15 Shillings.

Here, after *multiplying* by the firſt common *Subdiviſion* of a *Pound*, which is, into 20 *Shillings*, the Product comes out 1500, which being 4 *Figures*, and the given *Decimal* conſiſting but of 2 *Figures*, I cut off the 2 Surplus *Figures* towards the *Left-hand*, which are 15 *Shillings*; and the other 2 *Figures* towards the *Right-hand* being *Cyphers*, I conclude that 15 *Shillings* is the full *Value* of that *Decimal*.

*What*

*What is the Value of* ,378125 of a *Pound* Sterling?

20

Shillings 7,562500

12

Pence 6,750000

4

Farthings 3,000000

Here I *multiply* firſt by 20, and from the Product, which conſiſts of 7 *Figures*, I cut off 1 *Figure* towards the *Left-hand*, which in this *Example* is 7 *Shillings*, and leave 6 *Figures*, the Number of *Figures* in the given *Decimal*, for the next *Operation*. Now as 12 *Pence* make a *Shilling*, I *multiply* ,562500 by 12, and from this *Product*, which alſo conſiſts of 7 *Figures*, I cut off *one*, viz. that next the *Left-hand*, which is 6 *Pence*; then I *multiply* the remaining 6 *Figures* by 4, the *Farthings* in a *Penny*, and the *Product* comes to 6 *Cyphers* and a 3, which being cut off, as before, is 3 *Farthings* and 0 remains; ſo that the true Value of this *Decimal* is 7 s. 6 d. $\frac{3}{4}$.

*Note*, There are abundance of Caſes more, where there will be Remainders, after you have gone through the ſeveral Subdiviſions, than there is where there are none, as follows:

*What is the Value of* ,51296 *of a Pound* Sterling?

20

Shillings 10 | 25920

12

Pence 3 | 11040

4

44160

Here I find 10 *Shillings* and 3 *Pence*, and the *Remainder* is 11040, which being *multiply'd* by 4, gives but ,44040, which is but $\frac{44040}{1000000}$ Parts of a *Farthing*, which is not quite half a *Farthing*; and therefore in common we ſhould call

the Value of ,51296 of a *Pound* Sterling but 10 *Shillings* and 3 *Pence*.

*What is the Value of* ,74 *of a* Troy Weight?

| | | |
|---|---|---|
| | 12 | |
| Ounces 8 | 88 | |
| | 20 | |
| Penny Weights 17 | 60 | |
| | 24 | |
| 2 | 40 | |
| 12 | 0 | |
| Grains 14 | 40 | |

*Oz. Dwts. Gra.*
*Anſ.* 8 : 17 : 14 and ,40 remains, which is equal to $\frac{2}{5}$ of a *Grain*. As you may eaſily prove, by conſidering ,40 as the *Numerator*, and 100 as the *Denominator*; and then 'twill be $\frac{40}{100}$ of a *Grain*, which reduced comes to $0\frac{2}{5}$. You muſt proceed in the ſame Manner in all other *Weights*, *Meaſures*, &c.

## *Addition of* Decimals.

Here you have nothing more to do than to put the *Primes*, *Seconds*, *Thirds*, &c. exactly one under another, as you do the *Units*, *Tens*, *Hundreds*, &c. in whole *Numbers*; and then *add* up each *Row*, as if they were whole *Numbers*, and the *Total* is the Anſwer ſought. From which you muſt cut off as many *Figures* towards the *Right-hand*, as are in the biggeſt of the given Lines to be added, and if there are any left towards the *Left-hand*, they are whole Numbers. As,

| |
|---|
| ,562 |
| ,345 |
| ,786 |
| ,928 |
| ,941 |
| ,627 |
| 4,189 |

Here *adding* up the ſeveral *Figures* given, they come to 4189; but as the given *Decimals* conſiſt but of 3 *Places*, the fourth is ſeparated by a *Comma*; and ſhews that the *Total* of thoſe ſeveral Parts is 4 *Units* or whole Things, and 189 thouſand *Parts*. The like is to be obſerv'd in all other Caſes. As,

Suppoſe, the *Sums* given were theſe in the Margin. Here being whole *Numbers*, and *Parts* mix'd together, I *add* them as if they were all whole *Numbers*; only obſerve to keep each reſpective *Figure* in its due Place.

| |
|---|
| 56,27845 |
| 9,152.. |
| 719,3.... |
| 42,00009 |
| 5,712.. |
| 6,8271. |
| 5,00287 |
| 844,27251 |

*Note*, You are to obſerve, that here, and in all other Caſes, the *Decimals* are ſuppoſed to be Parts of the ſame *Integer*, viz. all *Parts* of a *Pound* in *Money*, or C's in *Weight*, a *Yard* or *Mile* in *Meaſure*, &c.

The

The *Decimals* in the *Examples* above, are a Mixture of pure or compleat *Decimals*, *Approximates*, *Circulates*, &c. and therefore the ſeveral *Totals* can be without Diſtinction really, but an *approximate* Sum, tho' they are conſider'd here as compleat or terminate Decimals only, and conſequently the Totals the ſame.

But when you are to *add* thoſe that *circulate*, or *repeat* a ſingle *Figure*, you need only continue them ſo far that they all *end* together; and then to the *Sum* or *Total* of the firſt *Line* towards the *Right-hand*, add as many *Units* as there are 9's in that *Line*, and the *Figure* ſo produced ſhall be a *Repetend* for the *Total*; and that the *Repetends* or *circulating* Figures may the more eaſily be known 'twill be proper to mark them thus: $\dot{1}$, $\dot{4}$, $\dot{3}$, &c. as in the following *Examples*.

| (1) | (2) | (3) |
|---|---|---|
| 5,$\dot{1}\dot{7}$ | 27,0$\dot{9}$6 | 134,252$\dot{1}\dot{7}$ |
| 6,$\dot{3}$3 | 13,41$\dot{9}$ | 618,958$\dot{3}$33 |
| 8,7$\dot{9}$ | 17,$\dot{3}$33 | 720,$\dot{8}$88888 |
| 5,24 | 62,1$\dot{5}$5 | 517,$\dot{1}$77777 |
| 6,$\dot{9}$9 | 31,$\dot{9}$66 | 316,02708$\dot{3}$ |
| 8,8$\dot{9}$ | 25,$\dot{8}$88 | 123,$\dot{9}$66666 |
| 41,9$\dot{1}$ | 177,52$\dot{1}$ | 2431,571520$\dot{1}$ |

In the firſt *Example*, the *Decimals* are continued only to two Places of *Figures*, becauſe the *Repetends* do not run any farther before they begin; as is the Caſe, at the 3, 4 and 6 *Lines*, where the *Repetends* are 6, 4 and 9; the *firſt*, *ſecond*, and fifth *Lines* beginning with the firſt Figure, and are therefore mark'd upon the firſt $\dot{1}$, $\dot{3}$, and $\dot{9}$. The ſecond *Example* is continued to three Places, becauſe the *Decimal* of the ſecond Line, which repreſents $\frac{1}{12}$, does not begin to repeat till it comes to the third *Figure*, which is 6. The third *Example* is continued to ſix *Places*, becauſe the *Decimal* of the fifth Line does not begin to have the repeating *Figures*, till you come to the ſixth *Place*. You are to obſerve the ſame upon all other Occaſions.

*To add* Decimals, *that have* compound Repetends.

Here you muſt make the *Repetends* all *begin* and *end* together; and that you may be accomodated the more eaſily, you may imagine your *Repetend* to begin at what *Figure* you pleaſe in the *Repetend*. As for Inſtance, Suppoſe the *Deci-*

*mal* of $\frac{1}{13}$ was given, which naturally is ,0454,0454, &c. but for Convenience you may make it 04,5404,5404,5404, &c. or 045,4045,4045, &c. or 0,4540,4540, &c. as may best suit your other *Numbers*; and when you have ordered your *Numbers*, add as before; only you must add to the *Total* of the first *Line* on the *Right-hand*, as many *Units* as are in the *Line*, where all the *Repetends* begin together.

,ø7692ȝ
,461538
,923076
,ø90909
,142857
,428571
2,123876

Here you will observe, that the *Total* of the first Line is 34, to which I add 2, the *Tens* in the last Line, where all the *Circulations* begin, and then 'tis 36; wherefore I set down 6, and mark it, as you see in the *Example*; then the whole *Total* will be two *whole Numbers*, and a circulating *Decimal* that consists of 123876,123876, &c. the *Demonstration* of which follows,

,ø7692ȝ is the *Decimal* of $\frac{1}{13}$
,461538 - - - - of $\frac{6}{13}$ } = 1 + $\frac{6}{13}$
,923076 - - - - of $\frac{12}{13}$
,ø90909 - - - - of $\frac{1}{11}$ = $\frac{1}{11}$
,142857 - - - - of $\frac{1}{7}$ } = $\frac{4}{7}$
,428571 - - - - of $\frac{3}{7}$

2,123876 is the *Decimal* to - - 2 $\frac{1234}{10001}$ the Total.

The Reason why in single *Repetends*, you add as many Units as there are 9's in the Line, where all the *Repetends* begin together, is, that the Total may be also a *Repetend*; the Truth of which appears plain from what follows,

,1 is the *Decimal* to $\frac{1}{9}$
,2 - - - to $\frac{2}{9}$
,3 - - - to $\frac{3}{9}$
,4 - - - to $\frac{4}{9}$
,5 - - - to $\frac{5}{9}$
,6 - - - to $\frac{6}{9}$
,7 - - - to $\frac{7}{9}$

3,1 the Total. 3 $\frac{1}{9}$ the Total.

The Sum of the *Decimals* is but 2,8, which without the 3, for the 3 Nines, would be $\frac{1}{10}$ too little, but with it is right; as plainly appears by the *Example* wrought by *vulgar Fractions*.

Sub-

### *Subſtraction of* DECIMALS.

You have nothing more to do, but to put the whole *Numbers* (if there be any) under one another, as in whole *Numbers*; and the *Primes*, *Seconds*, *Thirds*, &c. of the *Decimals* under one another, and then *ſubſtract*, as in whole *Numbers*.

### *EXAMPLES.*

| (1) | | (2) | | (3) | |
|---|---|---|---|---|---|
| From | ,62758 | From | 627,912 | From | 16758,---- |
| Take | ,49128 | Take | 159,939 | Take | 7598,1234 |
| Remains | ,13630 | Rem. | 467,973 | Rem. | 8159,8766 |

In the firſt and ſecond *Examples*, you *ſubſtract* all the ſame as if the given *Figures* were whole *Numbers*; only in the firſt *Example* you make the *Comma*, to ſhew they are all *Decimals*. In the ſecond *Example* you likewiſe *ſubſtract*, as if all the *Figures* were whole *Numbers*; only in the *Remainder* you make the *Comma* between the 3 and 4 *Figures*, becauſe there is the Commencement both of the whole *Numbers* and the *Decimals*. In the third *Example*, the upper Number is only a whole Number, but the under one that is to be ſubſtracted from it, is a mix'd Number, *viz.* 7598, are whole Numbers and ,1234 are decimal Parts; ſo that I borrow one Integer, which is 10000 Parts, and then ſubſtract the 1234 from it, as if it was a *vulgar Fraction*, and the Remainder is 8159 whole Numbers, and 8766 Parts.

More *EXAMPLES.*

| | | | | | |
|---|---|---|---|---|---|
| From | 29,17... | From | 965,219876 | From | 673,75892 |
| Take | 16,19875 | Take | 482,36.... | Take | 218..... |
| Rem. | 12,97125 | Rem. | 482,859876 | Rem. | 455,75892 |

*Note*, If the *Number* from which *Subſtraction* is to be made, have not ſo many *Figures* in the *decimal* Part, as the other, ſuppoſe *Cyphers* to be added, and then go on as before. As in the firſt *Example* of the laſt three

*To ſubſtract* Interminates *that have ſingle* Repetends.

You muſt make them *end* together, as in *Addition*; and then *ſubſtract*, as in whole *Numbers*: But if the *Number* that

is

is to be ſubſtracted, have the biggeſt *circulating Figure*; then inſtead of *ten*, you only *add* or borrow 9, and then go on as before.

| (1) | (2) |
|---|---|
| From 18,5186 | From 715,11333 |
| Take 12,9240 | Take 127,65367 |
| Rem. 5,5926 | Rem. 587,45965 |

*To ſubſtract compound* Repetends.

Prepare them as in *Addition*, and ſubſtract as in whole Numbers; only if you borrow one at the Place where both the *Repetends* begin, add one to the *Right-hand* of the ſubſtracting Number, and then the Remainder is the Anſwer, whoſe *Repetend* muſt be mark'd as in *Addition*.

| (1) | (2) |
|---|---|
| From ,461538 | From 58,090909 |
| Take ,076923 | Take 27,142857 |
| Remains ,384615 | Rem. 30,948051 |

Here the firſt *Example* is the *Decimal* of $\frac{5}{13}$, from which the *Decimal* of $\frac{1}{13}$ is ſubſtracted, and the *Remainder* is the *Decimal* of $\frac{4}{13}$, as you may very eaſily try: So the ſecond *Example* is the circulating *Decimal* of $\frac{1}{11}$, from which is taken the circulating *Decimal* of $\frac{1}{7}$; and the *Remainder*, after an *Integer* is borrowed and added, is $\frac{12}{77}$, whoſe *Decimal* is the ſame with the *Remainder*, to whoſe firſt *Figure* towards the *Right-hand* 7, *Unity* is added, becauſe the beginning *Figure* of the Circulation in the ſubſtracting Line is bigger than the other.

*Multiplication of* Decimals.

In the working this Rule, there is no manner of Difference between it and whole *Numbers*, all the *Art* lying in the valuing the *Product*; for which purpoſe obſerve this *General Rule*.

*Count how many* Decimals *are in both the* Multiplicand *and the* Multiplier, *and part off ſo many from the* Product; *but if the* Product *has not ſo many Figures in it, make them up by adding ſo many* Cyphers *as are wanting towards the* Left-hand.

| (1) | | (2) | |
|---|---|---|---|
| Multiply | ,57 | Multiply | 52,0003 |
| by | ,84 | by | ,0012 |
| | 228 | | ,06240036 Product. |
| | 456 | | |
| Product | ,4788 | | |

Here you see the first *Example* consists of *Decimals* only, and the *Product* is 4 *Figures*, which being the Number contained in both the *Multiplier* and *Multiplicand*, they are so many *Decimals*; but in the second *Example* the *Multiplicand* is a whole *Number* and a *Decimal*, and the *Multiplier* a *Decimal* only; and after the Work is done there comes out but seven *Figures*, whereas the Number of Places contained in the *Multiplicand* and *Multiplier* are 8; wherefore I am oblig'd to put a 0 on the *Left-hand*, to give the *Product* its true Value, as you see above. The like is to be observ'd in all other Cases.

But as it will frequently happen, that in multiplying by Order, to have the *Product* sufficiently near the Truth, *viz.* to 4, 5, 6, *&c.* Places at least, your given *Multiplicand* and *Multiplier* will consist of many *Figures*, and consequently the Operation will be tedious and troublesome; therefore, to prevent this Inconvenience, you may make use of the following *Contraction.*

*Consider with yourself, whether* 3, 4, 5, &c. *Places are necessary in the Product, to give a near Value to the produced Number, whether all* Decimals, *or mix'd with whole* Numbers; *then put the Unit's Place of the* Multiplier, *under that Place of the* Multiplicand, *you would have the Product be continued to, and invert the Order of all the Figures in the* Multiplier, *and begin every Line with the Figure that stands over the multiplying Figure, and add to that Product so many Units, as are Tens in the Product of the foregoing Figure; and observe, that if the said Product amounts to* 15, 25, 35, *or upwards, that you carry* 2, 3, 4, &c. *for them, as if they were* 20, 20, 40, &c. As you see done in the *Examples* following.

Suppose I wanted to *multiply* 276,38256 by 7,985, and would only preserve three *Places* of *Decimals*: I set down the *Multiplicand* as 'tis given, and then *invert* the *Multiplier*, as you see in the annexed *Example*, which is wrought both at *large*, and by the *contracted* Method, on pur-

purpoſe to ſhew you the Agreement between them, ſo far as they go; and alſo to ſhew you how many *Figures*, and how much Labour is ſaved, by working by the *contracted* Method.

| *Work at large.* | | *Contracted.* |
|---|---|---|
| 276,38256 | | 276,38256 |
| 7,985 | | 589,7 |
| 1381 | 91280 | 1934678 |
| 22110 | 6048 | 248744 |
| 248744 | 304 | 22111 |
| 1934677 | 92 | 1382 |
| 2206,914 | 74160 | 2206,915 |

Here you ſee that in the *Contraction*, all the Work at large, beyond the Line towards the *Right-hand*, is ſuperfluous, and the *Product* is nearly of the ſame Value, there being only in the third Place of *Decimals*, a 4, in the *common* Way, which is 5 in the *contracted* Way; which 5 is much nearer the *Truth* than the 4, becauſe 74, *&c.* follows, which is almoſt $\frac{1}{4}$ of another; ſo that the *Error* is but about $\frac{1}{4}$ of $\frac{1}{10000}$, or $\frac{1}{40000}$ Part of *Unity*, which, according to what your *Unit* is, will be of greater or leſſer Value. But if it had been required to have the *Decimal* continued to 4 Places, 'twould then have been exactly the ſame, for thoſe 4 Places with the common Way, and conſequently about $\frac{1}{26000}$ Part of *Unity* too little, as appears by the Work following.

In working theſe *Contractions*, I begin *multiplying* with the 7, the *Units* Place of the firſt *Multiplier*, that being the *Figure* that ſtands under the 2, in the firſt *Example* above, which is in the 3d *Place* of *Decimals*, and ſay, 7 Times 2 is 14; and becauſe the Amount of the foregoing Figure amounted to upwards of 35, I carried 4, as if it had amounted to 40, and then it makes 18, for which I ſet down 8 and carry 1, *&c.* as you ſee in the *Example*. That *Line* being done, I go to the next *Figure*, which is 9, and *multiply* that 8 that ſtands over it, by this 9, to whoſe *Product* 72, I add

| | |
|---|---|
| 276,38256 | |
| 5897 | |
| 19346779 | |
| 2487443 | |
| 221106 | |
| 13819 | |
| 2206,9147 | |

2,

2, for the 2 *Tens* contained in the *Product* of the next Figure 2, towards the *Right-hand*, which would have amounted to 23, had the other *Figures* alſo been *multiply'd* by the ſaid 9, as appears by that *Line* in the Work at large; but as it does not amount to 25, I carry but 2, and ſet down the 4 under the 8, and go on till the *Line* is done, which falls ſhort of the *Line* above it by a *Figure*, as you ſee in the Work at large, where 'tis the 2d *Line* from the *Bottom*, as 'tis here the 2d *Line* from the *Top*. The Reaſon of ſetting all the firſt *Figures* under one another, is to have the *Total* or *Amount* of that *Line*, where, in the Work at large, the 3d *Place* of *Decimals* meets in all the *Figures*, as appears by comparing the two Methods together. Then I go on to the 8, and *multiply* the 3 that ſtands over it, and to the *Product* add 7, for the Reaſons before mentioned, and ſo go on till all is done; as you ſee by the Work in both the *Examples*, where the *Decimal* is continued to both three and four Places. You are now to *Note*, That if no whole *Numbers* were mix'd with the *Multiplier*, that you muſt put a *Cypher* in the *Place* where the *Units* of the whole *Number* would have ſtood, ſuppoſing any to be there; as in this *Example*, multiply'd by ,985 *Decimal Parts* only, and requir'd to have left three *Places* of *Decimals* in the *Product* thus:

| | | |
|---|---|---|
| 276,38256 | Or thus for 4 Places. | 276,38256 |
| 589,0 | | 589,0 |
| 248744 | | 2487443 |
| 22111 | | 231106 |
| 1382 | | 13819 |
| 272,237 | | 272,2368 |

But if you have more than one *Place* of whole *Numbers* in your *Multiplier*, you muſt ſet the *Units* Place of the whole Numbess and the *Decimals*, in the Order you have already been ſhewn in the foregoing *Examples*; and the other *Figure* or *Figures*, towards the *Right-hand*, in an inverted *Order*; and then *multiply* as before, as you ſee done in the following *Examples*, where they are done for 3, 4, 5 and 6 Places of *Decimals* in the *Product*.

*Multiply* 9563,287468
1 by — 897,028794
2 by — 89,7028794
3 by — 9,87028794
4 by — ,987028794

And let the firſt *Product* have three *Places* of *Decimals* only; the 2d four *Places*; the 3d five; and the 4th ſix *Places*.

(1)

9563,287468
497820,798

7650629974
860695872
66943012
191266
76506
6694
861
38

8578544,223

(2)

9563,287468
4978207,98

7650629974
860695872
66943012
1911166
76506
6694
861
38

857854,4223

(3)

9563,287468
49782079,8

7650629974
860695872
66943012
191266
76506
6694
861
38

85785,44223

(4)

9563,287468
497820798,0

765062997 4
86069587 2
6694301 2
191266
76506
6694
861
38

8578,544223

If both the *Multiplicand* and the *Multiplier* are *Decimals*, having no whole *Numbers* in either, you muſt put a 0 under that Figure of the *Multiplicand*, that you would retain *Places* in the *Product*, for the *Units* Place of your *Multiplier*, as you ſee done in the *Examples*, Page 185, and at the 4th *Example* above, and work as before.

The

The next Thing to be taken Notice of is, the *multiplying* ſuch *Decimals* as have ſingle or compound *Repetends*, in which, if you would come to Exactneſs, you muſt obſerve the following Notes.

1. If the *Multiplicand* be a ſingle repeating *Interminate*, and the *Multiplier* a ſingle *Digit*, either having or not having one or more 0's before it, towards the *Left-hand*, you muſt *multiply* as in common *Numbers*; only to the laſt Place of the *Product*, towards the *Right-hand*, add as many *Units* as it contains 9's, and that ſhall be the true *Product*, repeating that laſt *Figure* ſo produced, as in the following *Examples*.

| | | |
|---|---|---|
| 76,20$ | 25,87$ | ,2786$ |
| 6 | ,8 | ,004 |
| 457,26$ | 20,698$ | ,0011146$ |

2. If the *Multiplier* be a *Repetend* to the *Product*, add a 0 to the *Right-hand*, which is the ſame as *multiplying* by 10, and *divide* that *Product* ſo increaſed by 9, continuing ſuch *Diviſion* till you come to a ſingle or compound *Repetend* in the *Quotient*, which *Quotient* ſo found, ſhall be the true *Product* of ſuch ſingle multiplying *Repetend*; as follows.

| | |
|---|---|
| 48,734 | 72,435 |
| ,8 | ,00$ |
| 9)146,2020 | 9),4346100 |
| 16,244$, &c. | ,4829$0, &c. |

3. If the *Multiplier* conſiſts of ſeveral *Figures*, whether mix'd with whole *Numbers*, or *Decimals* only, among which one is a *Repetend*, find the true *Product* of the *Repetend* Figure firſt, and then go on with the other *Figures*, as in whole *Numbers*, and as in the *Examples* following.

| | |
|---|---|
| 487,65 | 67,8926$ |
| 5,0$ | ,89$ |
| 9 \| 2925900 | 9 \| 40735580 |
| 3251$ the *Prod.* of $ | 4526173 |
| 2438250 the *Prod.* of 5,0 | 61103367 |
| | 5431410$44 |
| 2441,5010 whole *Prod.* | 60,4697049$ |

4. If the *Multiplicand* and the *Multiplier* have both ſingle *Repetends*, you *multiply*, as has been before ſhewn; and the *Product* of the particular *Lines* muſt be continued till they arrive at the *Figure*, where the *Repetends* all *terminate* together; as you ſee done in the 2d *Example* above.

5. If your *Multiplier* be a 9, that is, a *Repetend*, you may *divide* the *Multiplicand* by 9; and the *Quotient* will be your *Product*, as appears by the 4th *Example*, Page 187.

6. If the *Multiplicand* have a compound *Repetend*, and the *Multiplier* be a ſingle *Figure*, *multiply* as in common Numbers, and add to the *Product* of the *Right-hand* Figure of the *Repetend*, ſo many *Units* as there are *Tens* in the Product of the *Left-hand* Figure of the ſaid *Repetend*.

Thus, — 627,8$\dot{6}4\dot{8}$
8

5022,9165

7. If the *Multiplier* has likewiſe many Figures, *multiply* by each, as before taught; and continue the *Repetends* till they all end at one *Figure*; and then add as before taught in *Addition*, Page 180.

Thus, — 417,6$\dot{3}2\dot{8}$
76,45

2088164
1670530
2505795
2923477

31928,007$\dot{1}\dot{7}$

8. If the *Multiplier* conſiſts only of a compound *Repetend*, without any *terminate* Figures, *multiply* by each Figure of the *Repetend*, as in whole *Numbers*, and add the ſeveral particular *Products* together, and to that *Total* add itſelf in the following Manner. Firſt, ſet the firſt *Figure* towards the *Left-hand*, ſo many Places forward, towards the *Right-hand* beyond itſelf, as the *Repetend* conſiſts of Figures, and the reſt in order following; and ſo go on till the laſt *Total* reaches beyond the firſt Figure of the Product on the *Right-hand*; then add theſe ſeveral *Lines* together, beginning under the *Right-*

*Right-hand* Place of the first *Product*; and if the next Figures beyound come to *Ten*, carry 1, and dash off from thence so many *Figures* for a *Repetend*, as the *Repetend* of the *Multiplier* consists of.

Multiply — 4271,36
by — ,7436

2562816
1281408
1708544
854272

1040,503296
1040500, &c.
104, &c.

1040,607356

Here the *Multiplier*, consisting only of a *Repetend*, after the *Multiplication* is finish'd, I repeat so many Figures of the *Product* as will reach one *Figure* beyond the *Product*, setting down the *first* Figure under the *Fifth*, because the *Repetend* in the *Multiplier* consisted of four *Places*; and then I count the same Number a 2d Time from that, and do the same again, as you see in the *Margin*.

9. If the *Repetend* of the *Multiplier*, consisting of many *Figures*, have one or two *terminate* Figures *added* to, or *join'd* with it, set those *terminate* Figures under the Figures of the *Repetend*, from the *Right-hand* to the Left, and *substract*, and esteem the *Remainder* as a *Repetend*, with which work as above.

Multiply 789,4378 Multiplicand,

by 6,7436 Multiplier.
Substract — 6 the terminate Figure,

and — 6,7436 is the new Multiplier.

236831340
31577512
23683134
47366268

5007,40396540
500740396, &c.
50074, &c.

5007,90475586 the true Product.

Here

Here you see that there is only one *terminate* Figure in the *Multiplier*, viz. the 6, which being set under the 6, towards the *Right-hand*, and *substracted*, the *Remainder* is 6,3436 for a new *Multiplier*; and then the Work is perform'd, as you see in the last *Example*.

10. If the *Multiplier* has several *terminate* Figures join'd with the *Repetend*, and the *Repetend* consists of but a few Places, work the *repetend* Figures first, as before in Numb. 9; and then to this *Product*, add the *Product* of the other Figures, and the whole *Product* will be the true *Product* sought.

Multiply 432,43
by 23,414

172972
43243

60,5402
60540, &c.
605, &c.
6, &c.

61,1517 Prod. of the *Repetend* 14
1729720
129729
86486

10124,97714 whole Product.

11. If both the *Multiplicand* and the *Multiplier* are *interminate*, or have compound *Repetends*, the Number of Places of the *Repetend* in the *Product*, will be various and uncertain, which must be determin'd by continuing and repeating the first *Product*, which still contains a *Repetend* equal to the Number of Places in the *Multiplicand*.

The Managing of those *Multiplicands* and *Multipliers*, that have large *Repetends*, consisting of many *Figures*, requires a great deal of Pains and Trouble, and is more curious than useful, and therefore I shall not prosecute them any further; for 'tis very rare that any *Product* can require above six *Places* of *Decimals*, and commonly 3 or 4 are sufficiently exact; therefore what has already been taught, will fully answer all necessary Occasions, for which reason I will now go on to

*Division*

## *Division of* DECIMALS.

Which is the same with *Division* of whole *Numbers*, respect being had to distinguish the true Value of the *Quotient*; which may be done by this General Rule, *viz.*

*If the* Divisor *be large, add to the* Dividend *as many* Cyphers *as you think convenient, in order to make the* Quotient *have a sufficient Number of* Decimal *Places, when it so happens that there will be a continual* Divisor, *to render the Answer tolerably exact; and in those Cases, where you cannot render it compleat, you must continue it to* 2, 3, 4, 5, 6, &c. *Places, more or less, according to the Value of the* Integer; *and to know when you have so done, you must count the Number of* Decimal *Places in the* Dividend, *reckoning the* Cyphers *that were added, if any; and then count the Number of* Decimal *Places you have in the* Divisor, *the Number of which substract out of the Number of those of the* Dividend, *and the Difference is the Number of* Decimal *Places that must be in the* Quotient; *and if there are not so many Figures in the* Quotient, *as the said Difference so found amounts to (as in some Cases there will not) then add so many* Cyphers *on the* Left-hand *of the said* Quotient *as will make them up, and then that* Decimal *will be the Answer sought. Likewise if the* Dividend *have not so many* Decimal *Places as the* Divisor, *you must add so many* Cyphers *at least, as to make them up; and then the* Quotient *will be all whole Numbers; therefore if the Remainder be any thing considerable for Value, continue adding still more* Cyphers, *and divide as before to have* 1, 2, 3, 4, &c. *Places of* Decimals.

The following *Example* may serve as an Illustration of the whole Work.

Suppose 'twas requir'd to *divide* 3215862756384 by 789654.

The *Quotient* would be 4072495, and the *Remainder* will be all 0's.

Now, according to the Number of *Decimals* and whole *Numbers*, you will suppose in either the *Divisor* or *Dividend*, the *Quotient* will be of a greater or lesser *Value*. As, suppose the *Divisor* all whole *Numbers*, and the *Dividend* consisted of six Places of whole *Numbers*, and seven Places of *Decimals*; then the *Quotient*, which consists of seven Figures, will be all *Decimals*: But if the *Divisor* was all *Decimals*, and the *Dividend* all whole *Numbers*, you must imagine six *Cyphers* to be added to the *Dividend*, and then the *Quo-*

*tient* will be expreſs'd in its true *Value*, having thirteen Figures, which are all whole Numbers, *viz.*

4072495000000.

Again, Suppoſe the *Diviſor* conſiſted of three whole *Numbers*, and three *Decimal* Places, *viz.* 789,654, and the *Dividend* was as before 321586,2756384, the *Quotient* would be 407,2495; and ſo on in all the Caſes and Varieties that may, or can happen, with many or few Places of whole *Numbers* or *Decimals*.

The following Notes may be of great Uſe, in many particular Caſes, *viz.*

1. If you are to divide any Number by 10, 100, 1000, *&c.* you have nothing more to do but to make the ſeparating *Point* 1, 2, 3, *&c.* Places more, towards the *Left-hand*, than it ſtood before, and you have the *Quotient* or true *Anſwer* ſought. And this in many Caſes of *Trade* and *Buſineſs* may be very uſeful, as ſhall be hereafter ſhewn in the *Rule* of *Practice*, &c.

2. If you would have a fix'd *Number*, and ſo *multiply* inſtead of *dividing*, add *Cyphers* to *Unity*, and *divide* by the given *Diviſor* till 0 *remains*, and the *Quotient* ſhall be the *Multiplier* ſought.

As, Suppoſe I would *multiply* the Number 345 by an equivalent *Factor*, to make the *Product* equal in *Value* to the ſame Number *divided* by 5. In this Caſe my *Multiplier* muſt be ,2; as appears by the following Work.

```
5 | 345 |
    69   Quotient.
```

```
  345
  ,2
 ----
 69,0   Product.
```

Again, Suppoſe I was to *divide* by 125; inſtead thereof, I *multiply* by ,008: Thus,

```
125 | 15000 | 120
    125
   ----
    250
    250
   ----
      00
```

```
 15000
 ,008
 ----
120,000
```

Again,

Again, Suppose I was to divide the Number before mentioned by 8, my *Multiplier* would be 125; as appears by the following Work.

| | |
|---|---|
| 8 \| 15000 | 15000 |
| 1875 *Quotient.* | ,125 |
| | 75000 |
| | 180000 |
| | 1875,000 *Product.* |

After the same Manner you may go on with any other Figures, regarding only the Value of the *Divisor* or *Multiplier*, which will determine the Value of the *Quotient* or *Product*, by the Rules heretofore taught you.

And contrarily you may convert a *Multiplier* into a *Divisor*, by dividing *Unity* with a proper Number of *Cyphers*, by the given *Multiplier*, and the *Quotient* shall be the *Divisor* sought. As, suppose, instead of *multiplying* any Number by ,03125, I would *divide* the said Number, so that the *Quotient* should be of the same Value with the *Product*; *What must be the* Divisor?

Answer, 32. For by dividing *Unity* by ,03125, there comes out 32 whole *Numbers* for the *Divisor*. Now *multiplying* any Number by a *Fraction* gives the *Product* less than the *Dividend*, in the same Proportion that the multiplying *Fraction* bears to *Unity*; as was observ'd to you in the *Multiplication* of Vulgar *Fractions*, Page 157, and will evidently appear by the following *Example*.

*Multiply* 3456 by ,03125, and the *Product* will be 108. Likewise if you divide 3456 by 32, the *Quotient* will be 108; as appears plainly by the Work at large here-under.

| | |
|---|---|
| 3456 | 32 \| 3456 (108 |
| ,03125 | 32 |
| 17280 | 256 |
| 6912 | 256 |
| 3456 | |
| 10368 | |
| 108,00000 | |

But if 'twas to be in *Queſtions*, where many *Statings* in the *Rule* of Three was concern'd, as in *Fellowſhip*, &c. then you muſt *divide* the ſecond Number by the firſt, and that *Quotient* will be the common *Multiplier*; as ſhall be ſhewn hereafter.

3. As in *Multiplication*, where the Factors were large, ſo in *Diviſion*, where the *Diviſor* and *Dividend* conſiſt of many *Figures*, the Work may be very much ſhortned, and the Quotient ſtill retain the true Value to 3, 4, 5, 6, *&c.* Places. Firſt determine how many *Figures* you will have in the *Quotient*, and then *multiply* the *Diviſor* with the firſt 2, *&c. Quotient* Figures, as in common; but for every Figure after, ſkip one, adding to the next Figure what would have been carried, if it were not ſo cut off; as in the following *Example*, where I am deſirous of having three Places of *Decimals* in the *Quotient*.

*Be the Diviſor. The Dividend. The Quotient.*

Let 21,234 (1236,97286790 (58,254

1061,70

275.27

16987

540

425

115

106

09

8

1

Here I only *multiply* the firſt Line whole, and drop the 4; the next Line the 3, the next the 2, the next 1, *&c.* but carry 1, 2, 3, *&c. Tens*, if the *Product* of the foregoing Figure comes from 5 to 10, from 15 to 20, from 25 to 30, *&c.* The whole Work at large will ſtand thus:

*Whole*

*Whole Work at large.*

21,234 | 1236,9728 : 6790 (58,25435
106170 :

175272 :
169872 :

54008 :
42468 :

11540 : 6
10617 : 0

923 : 67
849 : 36

74 : 319
63 : 702

10 : 6170
10 : 6170

. . : . . . . Remains.

*Whole Work contracted.*

21,234 | 1236,9728.6790 (58,25435
106170

175272
169872

54008
42468

11540
10617

923
849

74
64

10
10

. . Remains.

As you have been taught to manage *circulating* Numbers, in the three foregoing Rules; ſo you ſhall be here alſo taught what may be generally neceſſary in *Diviſion*, and therefore I will proceed gradually, and ſhew you,

1. *To divide any given Number that has a ſingle* Repetend, *by one or more terminate Figures.*

Here you muſt *divide* as in whole *Numbers*, and continue your *Diviſion* till you have a ſingle or compound *Repetend* in your *Quotient*, one of which will generally come out pretty ſoon; and tho' ſome *Diviſors* will produce a *Repetend* much ſooner than others, and ſome will never come to a *Repetend*, as appears by the following *Dividend*, having the terminate *Digits*, 2, 3, 4, 5, 6, 7, 8, 9, for *Diviſors*.

2 | 3279.643 Dividend.
| 1639.821ϕ, &c. Quot.

3 | 3279.643 Dividend.
| 1093.214, &c. Quot.

In theſe two *Examples* the 1ſt repeats from the taking down of the 2d Figure of the *Repetend* in the *Dividend*, and the 2d from taking down the 1ſt Figure of the *Repetend* in the *Dividend*.

4 | 3279.643 Dividend.
819.910833, &c. Quot.

In this *Example*, the *Quot.* begins to repeat at taking down the 3d Figure of the *Repetend* in the *Dividend*.

5 | 3279.643 Dividend.
| 655.92866, &c. Quot.

6 | 3279.643 Dividend.
| 546.60712, &c. Quot.

In theſe two *Examples* the *Quotient* begins to repeat at the taking down of the 2d Figure of the *Repetend* in the *Dividend*; theſe 5 *Examples* all produce ſingle *Repetends* in the *Quotient*.

7 | 3279.643 Dividend.
| 468.52ϕ4761ϕ9047, &c. Quotient.

9 | 3279.643 Dividend.
| 364.4048ϕ, &c. Quotient.

In theſe two *Examples*, where the Diviſors are 7 and 9, the *Quotients* contain the compound *Repetends*, ϕ4761ϕ, and .48ϕ, both beginning at the taking down of the firſt Figure of the *Repetend* in the *Dividend*.

8 | 3279,643 Dividend.

| 409,9554166, &c. Quot.

In this *Example* the *Quotient* repeats a single Figure, beginning at the 4th Figure of the *Repetend* in the *Dividend*.

Again, Suppose 79,26 divided by 4,8 and 23,4

4,8 | 79,26 | is 16,5313 88, &c.

But if the same *Dividend* was divided by 34,5, the *Quotient* would be

2,29738454106280193236714958, &c.

which has a *Repetend* of 22 Figures.

And 195,07 by ,48 has 406,29, &c. for the *Quotient*. 'Tis needless to express these Divisions at large, the Work being the same with common Numbers; only you must mind to take down the *Repetend* Figures of the *Dividend*, every time you make a Figure in the *Quotient*, as in the three last *Examples*; in the first and last of which 48 is the *Divisor*; and in the first, you continually take down 6; and in the last you continually take down 2, &c.

2. If your given *Divisor* be a single *Repetend*, and your *Dividend* a terminate *Number*, multiply the *Dividend* by ,9, and *divide* that *Product* by the given *Divisor*. As,

*Suppose*, 789,1234 *was to be divided by* 6, 7, 8, &c.

,9

,6 | 710,21106 the new *Dividend*.

| 1183,6851 *Quotient* by 6.

7 | 1014,5858 Ditto by 7.

8 | 887,763825 Ditto by 8.

Or you may *subtract* $\frac{1}{10}$ of the given *Dividend* from it self, and the *Remainder* divide by the given *Repetend*, thus:

789,1234.
78,91234

710,21106 the new *Dividend*, as before.

The

The Reason of this Process is, because all single Figures that are *Repetends*, are but so many *Ninths* of *Unity*; tho' when they stand without that Mark, they are so many *Tenths*; therefore when you *multiply* the given *Dividend* by ,9, 'tis the same thing as substracting $\frac{1}{10}$ of itself, from it self; as appears by the foregoing Work: Or you might have continued the Work at large, having regard to the multiplying and substracting *repetend Decimals*, as has before been taught you.

Thus 9) 789,12340000 ( 1183,6851
666,66666666

122456733333
6666666666

5579006666
5333333333

245673333
200000000

45673333
40000000

5673333
5333333

340000
333333

6666, &c.
6666, &c.

0000

If the *Divisor* has *terminate* Figures join'd with the *Repetend*, substract those *terminate* Figures from the whole *Divisor*, and call the *Remainder* a new *Divisor*; and prepare the *Dividend* as above taught, and work with the new *Divisor* and *Dividend*, as in whole Numbers.

67,48

67,48 | 3469,2875.
674 | 34692875

60,74 | 3122,35875 (51,405
30370

8535
6074

24618
24296

32275
30370

1905, &c.

If the given *Diviſor* has a compound *Repetend*, join'd to one or more terminate *Figures*, ſet it under it ſelf ſo many Places towards the *Right-hand*, as the *Repetend* conſiſts of Figures, and *ſubſtract* as before, and the *Remainder* ſhall be a new *Diviſor*; likewiſe do the ſame by the given *Dividend* for a new *Dividend*, with which new *Diviſor* and *Dividend* work as in whole *Numbers*: But if the given *Diviſor* has a *Repetend*, and no terminate *Figures*, you muſt not ſubſtract any thing from it; but the Subſtraction muſt be made from the *Dividend* only, even tho' it ſhould conſiſt of all whole *Numbers*, obſerving always to put the *Dividend* ſo many Places forwards as the *Repetend* of the *Diviſor* conſiſts of *Figures*; and if the *Diviſor* has no *Repetend* in it, then you muſt not *ſubſtract* from either the *Diviſor* or *Dividend*, although the given *Dividend* ſhould have a *Repetend*.

*Examples of each Sort follow.* And firſt the *Diviſor* joined with *Terminates*.

Divide

Divide 10124,977 1/4 by 23,414

23,414) 10124,977 1/4 (
234 10124977

23,1810) 1002372740 (432,43
9272

7517
6954

5632
4636

9967
9272

6954
6954

Here in this *Queſtion*, the Anſwer is compleat, leaving no *Remainder*, and the *Quotient* is *terminate*; but ſuppoſing the ſame *Numbers* given, and only let the *Diviſor* be all of it imagined a *Repetend*; then there will be a continual *Remainder*, and the Quotient of courſe can only be an *Approximate*.

23.414 | 10124,977 1/4
10124

) 10124,87593 (432,42
93656

75927
70242

56855
46828

100279
93656

66233
46828

19405 *Remains.*

To

to add as many *Cyphers* as you pleaſe, ſuppoſe 10, and continue dividing, the *Quotient* will be increaſed to 432,4282877765 43, and the *Remainder* will be 11254; and ſo you may go on as long as you will.

But if the ſame *Diviſor* had been either a compleat *Decimal* or an *Approximate*, and ſo had no *Repetend*, then the *Quotient* would have been 432,43, *&c.* and the *Remainder* 6115, *&c.*

Before we leave this *Head*, it may be proper to take Notice of the Reaſon of the laſt *Rule*, Page 199, and of the laſt *Example* in Page 200, wrought in conſequence of that *Rule*. The *Example* is 10124,977$\frac{1}{1}$, *divided* by $\frac{1}{3,414}$: Here *Subſtraction* is made from the *Dividend* only, for if the *Diviſor* was imagined to be repeated thus, $\frac{1}{3414}$, $\frac{1}{3414}$, *&c.* then it would ſtand thus:

$\frac{1}{3414}$, $\frac{1}{3414}$, *&c.*
$\frac{1}{3414}$, *&c.*

$\frac{1}{3414}$,00000 Remainder.

For removing the *Repetend* of the *Diviſor*, under its proper Place, it would ſtand under the 2d, 3d, *&c.* *Repetition*, and the *Remainder* will be 23414, only; for *Cyphers* on the *Right-hand* of a *Decimal* neither increaſe nor diminiſh its Value, as has been already obſerv'd. You may obſerve likewiſe, that the *Quotient* of this laſt *Example* is a ſmall Matter leſs than the *Quotient* of the *Example* above it, by ſuppoſing the whole *Diviſor* in the laſt to be a *Repetend*, and only a Part of it to be ſo in the other; and this will always be more or more leſs, in Proportion to the Largeneſs or Smallneſs of the *Repetend* given; for if you continue the Work of the laſt *Example*, Page 200, the *Quotient* would be increaſed to 432,4282877765, *&c.*

The Deſign of the ſeveral *Operations*, in the various Sorts of *Repetends*, is to render the Anſwer by *Decimals*, as perfect as by Vulgar *Fractions*, which in many Caſes, without ſuch Allowances, could not be, as appears from the ſeveral *Examples* themſelves, when compar'd together; for without the foregoing Subſtractions, or conſidering the *Diviſors* as *Repetends*, they would then be the ſame as if 'twas $10124\frac{2111}{100000}$ divided by $23\frac{414}{1000}$, which according to the Rules

for dividing Vulgar *Fractions*, would make the *Quotient* to be $\frac{12132277117020}{2541400000}$.

Enough has been ſaid of the preparatory *Rules* of *Decimals*. We ſhall now proceed to ſhew the Uſe of them in working *Queſtions*.

*Decimals* are exceedingly uſeful in all fix'd Caſes, *viz.* where particular *Quantities* or *Prices* are conſtantly us'd; for by making a ſmall *Table*, you may with very little trouble, tell the Amount of any Parcel of Goods whatever, and in many thouſands of Inſtances by Inſpection, as ſhall be preſently ſhewn; but the firſt neceſſary Thing will be, to teach you the Method of making proper *Tables* for all manner of Purpoſes, for theſe ſort of Tables are generally deſign'd for particular Uſes; but the Method of making them is univerſal. As, ſuppoſe I wanted to have conſtantly by me the *Decimals* to the ſeveral Parts of *Coins*, *Weights*, *Meaſures*, *Time*. &c. I ſet down the Parts as a Vulgar *Fraction*, and find the *Decimal* thereof, as has been taught you, Page 168. Thus:

*What is the* Decimal *to a* Farthing?

A *Farthing* being the $\frac{1}{960}$ Part of a *Pound*, the *Decimal* to this Vulgar *Fraction* is, ,001041ϐ, which being multiply'd by 2, as taught Page 187, the *Product* will be ,00208ϗ for the *Decimal* of two *Farthings*: Or you may conſider it as the $\frac{4}{960}$ of a Pound, and divide as above for the *Farthing*, obſerving, that whenever you come to a ſingle *Repetend*, you need go no further than the firſt *Figure*. The ſame may be done for 3 *Farthings*, and the *Decimal* will be ,003125. In like manner the *Decimal* of a *Penny* will be ,00416, of 2 *Pence* ,0083, of 3 *Pence* ,0125, of 4 *Pence* ,016ϐ, of a *Shilling* ,05, of 2 *Shillings* ,1, of 3 *Shillings* ,15, &c. Theſe being regularly ſet down in a Table, as hereafter ſhall be done, you need only look for what you want, and if you can't have it at *once*, take it at *twice*, regarding the Value of the reſpective Places, and *add* them together; the *Sum* or *Total* will be the *Decimal* required. As, Suppoſe I wanted the *Decimal* of 3*s*. 3*d*. ¼ I look into the *Table* and find the *Decimal* of 3*s*. to be ,15, of 3 *Pence* 3 *Farthings* to be ,015625; theſe added together make ,165625, being both *terminate* Numbers, or perfect *Decimals*, as you may try by bringing the whole into 3 *Farthings*'s, and they will make 53 for the *Numerator* or

*Dividend*; and then 320, the 3 *Farthings* in a *Pound*, will be the *Denominator* or *Diviſor*; the *Quotient* ariſing from the Work will be ,165625; as appears from the *Example* following.

32 | 0 | 53 - - - (,165625

32

210
192

180
160

200
192

80
64

160
160

...

The like may be done in all other Caſes, whether they be *Coins*, *Weights*, *Meaſures*, *Time*, &c. regarding the Proportion that the lower *Species* bears to the upper *Species*, or that which is the *Integer*; for here, if a *Shilling* or a *Crown*, &c. were ſuppoſed to be the *Integer*, then the *Decimal* of a *Farthing*, a *Penny*, &c. would be different in Figures, tho' not in its real Value, from what 'tis here made to be: For Inſtance, Suppoſe a *Shilling* was to be eſteemed the *Integer*, then the *Decimal* of a *Farthing* would be ,02833, *viz.* 20 Times bigger, or nearer to an *Integer*, than 'tis now a *Pound* is the *Integer*; becauſe the *Price* or *Value* of the *Species* laſt mentioned, is but $\frac{1}{20}$ Part of the former. The like will always happen in all Caſes whatever, in Proportion to the *Integers* being conſider'd of a larger or ſmaller Value; but whenever *Money* is concern'd, I would always recommend a *Pound* Sterling to be the *Integer*, and then you may value the Amount of your Work, either by the Directions given you, Pages 176 and 177, or by the following *Rule*, which with a little Practice will be much readier, ſhorter and eaſier, and at the ſame time ſufficiently exact for all common Buſineſs.

*The* RULE.

*If the* Prime's *Place, or the firſt* Figure *on the Left-hand of your given* Decimal, *be any ſignificant Figure,* double *it, and reckon the Amount of that Double ſo many* Shillings; *then*

*go to the two next* Figures, *and for every* 25 *reckon* Six-pence, *which* add *to the former Sum*; *and if any thing ſtill remains, and is under* 15, *reckon them for ſo many* Farthings, *and* add *them to the* Sum *before found*; *but if above* 15, *abate* 1, *and reckon the* Remainder *as ſo many* Farthings, *which add as before, and the Work will be ſufficiently exact for all common* Caſes. As, ſuppoſe I take the ſame *Examples*, as are in Pages 176 and 177, *viz.*

*What is the Value of* ,75 Decimal *Parts of a Pound* Sterling? *Anſwer*, 15 Shillings.

Firſt, I double the 7, and it comes to 14; then to the 5 I add 0 to make it two Figures, and it is 50, which contains 25 *twice*; which by the above *Rule* is two *Six-pences*, or one *Shilling*, which *added* to 14 *Shillings* make 15 *Shillings*, as in Page 176. Again,

*What is the Value of* ,378125 *of a Pound* Sterling? *Anſ.* 7 *s.* 6 *d.* ¼. For doubling the 3 it makes 6, then the two next Figures being 78, is 3 Times 25 and 3 over; which is 3 *Six-pences* and 3 *Farthings*; ſo that the whole is 7 *s.* 6 *d.* ¼, the ſame with Page 177. Again,

*What is the Value of* ,51296 *of a Pound* Sterling? *Anſ.* 10 *s.* 3 *d.* For 5 doubled is 10 Shillings; then the two next Figures are 12, which are 12 *Farthings* or 3 *Pence*. So if I enquire the Value of ,06932, *&c.* of a *Pound* Sterling, the *Anſwer* by the above *Rule* will be 1 *s.* 4 *d.* ½; which being wrought by the Directions given in Page 176, comes to the ſame; as appears by the Work at large here-under.

```
                ,06932
                    20
              ---------
1 |           38640
  |              12
  ---------------------
4 |           63680
  |               4
  ---------------------
2 |           54720
  ---------------------
```

The Parts which remain at laſt, being leſs than a *Farthing*, are always rejected, becauſe in *Buying* and *Selling* no Body can pay leſs than a *Farthing*; but in *Computations* where the Price of one Thing may be given at the Parts of a *Farthing*, and the Price of many is required, you muſt then work with the whole Number and only reject the Parts in the *Total Amount*. Now that no Caſe may happen wherein you may be at a Loſs, I will give two or three *Examples* more of this Kind.

*What is the Value of* ,00976, *&c. of a Pound* Sterling? Anſwer, 2 *d.* ¼. Here the firſt *Figure* is a 0, conſequently the *Amount*, when doubled, is ſtill 0, and the two next

*Figures*

*Figures* are 09, which ſtanding but for 9 in *Numeration*, muſt be deemed 9 *Farthings*, or 2 *d.* ¼. So the Value of ,8023, *&c.* is 16 *s.* 00 *d.* ½, of ,01741, *&c.* is 4 *d.* *Note*, If it exceeds 15, the Value of the given *Decimal* will be a *Farthing* too little by this Rule, when the fourth *Figure* is an 8 or a 9; and alſo a *Farthing* too much, if the given *Decimal* is under 15, when the fourth *Figure* is 0, 1, 2, 3 or 4; as will more fully appear by the following *Table* of *Decimals*, for *Shillings*, *Pence* and *Farthings*, a *Pound* Sterling being the *Integer*.

A Pound *Sterling* the *Integer*.

| Farthings | Decimals. |
|---|---|
| 1 | ,001041ϕ |
| 2 | ,00208ʒ |
| 3 | ,003125 |

| Pence | Decimals. |
|---|---|
| 1 | ,0041ϕ |
| 1 ¼ | ,005208ʒ |
| 1 ½ | ,00625.. |
| 1 ¾ | ,007291ϕ |
| 2 - | ,008ʒ |
| 2 ¼ | ,009375. |
| 2 ½ | ,01041ϕ |
| 2 ¾ | ,011458ʒ |
| 3 - | ,0125 |
| 3 ¼ | ,013541ϕ |
| 3 ½ | ,01458ʒ |
| 3 ¾ | ,015625 |
| 4 - | ,016666.. |
| 4 ¼ | ,017708ʒ |
| 4 ½ | ,01875.. |
| 4 ¾ | ,019791ϕ |
| 5 - | ,0208ʒ |
| 5 ¼ | ,021875. |
| 5 ½ | ,022916ϕ |
| 5 ¾ | ,023958ʒ |
| 6 - | ,025.... |
| 6 ¼ | ,026041ϕ |
| 6 ½ | ,027083. |
| 6 ¾ | ,028125. |
| 7 - | ,0291ϕ.. |
| 7 ¼ | ,030208ʒ |

| Pence. | Decimals. |
|---|---|
| 7 ½ | ,03125.. |
| 7 ¾ | ,032291ϕ |
| 8 | ,033.... |
| 8 ¼ | ,034375. |
| 8 ½ | ,03541ϕ. |
| 8 ¾ | ,036458ʒ |
| 9 | ,0375... |
| 9 ¼ | ,038541ϕ |
| 9 ½ | ,03958ʒ. |
| 9 ¾ | ,040625. |
| 10 | ,041ϕ... |
| 10 ¼ | ,042708ʒ |
| 10 ½ | ,04375.. |
| 10 ¾ | ,044791ϕ |
| 11 | ,0458ʒ.. |
| 11 ¼ | ,046875. |
| 11 ½ | ,047916ϕ. |
| 11 ¾ | ,048958ʒ |

| Shillings. | Decimals. |
|---|---|
| 1 | ,05 |
| 2 | ,1 |
| 3 | ,15 |
| 4 | ,2 |
| 5 | ,25 |
| 6 | ,3 |
| 7 | ,35 |
| 8 | ,4 |
| 9 | ,45 |
| 10 | ,5 |
| 11 | ,55 |

| Shillings. | Decimals. |
|---|---|
| 12 | ,6 |
| 13 | ,65 |
| 14 | ,7 |
| 15 | ,75 |
| 16 | ,8 |
| 17 | ,85 |
| 18 | ,9 |
| 19 | ,95 |

EXPLANATION.

By this *Table* you may find the *Decimal* to any Part of a Pound *Sterling*. Thus, ſuppoſe I wanted 9 *d.* ½, I look under the *Title* of *Pence*, and at 9 ½ ſtands ,039583 for its *Decimal*. Again, If I want the *Decimal* to 13 *s.* 10 *d.* ¼, firſt look for 13 *Shillings*, which is ,65 then 10 ¼ is ,042708ʒ

*Tot.* is ,692708ʒ

for

for the *Decimal* requir'd. But ordinarily ,6927 would serve, the other three *Figures* being of but small Value; only in the *Tables* I have put down all the *Figures*, till they either *terminate* or *repeat*; but in all common Cases, 3 or 4 *Figures* are sufficient, because the Defect, if any, will be too insignificant to be taken Notice of.

TROY WEIGHT. A Pound the *Integer*.

| Ounces. | Decimals. |
|---|---|
| 1 | ,0833 |
| 2 | ,1666 |
| 3 | ,25.. |
| 4 | ,3333 |
| 5 | ,4166 |
| 6 | ,5... |
| 7 | ,5833 |
| 8 | ,6666 |
| 9 | ,75.. |
| 10 | ,8333 |
| 11 | ,9166 |

| Dwts. | Decimals. |
|---|---|
| 1 | ,0041$\frac{6}{}$ |
| 2 | ,0083 |
| 3 | ,0125. |
| 4 | ,0166$\frac{6}{}$ |
| 5 | ,0208$\frac{3}{}$ |
| 6 | ,025.. |
| 7 | ,0291$\frac{6}{}$ |
| 8 | ,0333 |
| 9 | ,0375. |
| 10 | ,0416$\frac{6}{}$ |
| 11 | ,0458$\frac{3}{}$ |
| 12 | ,05... |
| 13 | ,0541$\frac{6}{}$ |
| 14 | ,0583 |
| 15 | ,0625. |
| 16 | ,0666 |

| Dwts. | Decimals. |
|---|---|
| 17 | ,0708$\frac{3}{}$ |
| 18 | ,075.. |
| 19 | ,0791$\frac{6}{}$ |

| Grains. | Decimals. |
|---|---|
| 1 | ,0001736$\frac{1}{}$ |
| 2 | ,0003472 |
| 3 | ,0005208$\frac{3}{}$ |
| 4 | ,000694 |
| 5 | ,0008680$\frac{5}{}$ |
| 6 | ,0010416$\frac{6}{}$ |
| 7 | ,0012152$\frac{7}{}$ |
| 8 | ,0013$\frac{8}{}$ |
| 9 | ,0015625 |
| 10 | ,0017361$\frac{1}{}$ |
| 11 | ,0019097$\frac{2}{}$ |
| 12 | ,002083 |
| 13 | ,0022569$\frac{4}{}$ |
| 14 | ,0024305 |
| 15 | ,0026041$\frac{6}{}$ |
| 16 | ,00277 |
| 17 | ,0029513$\frac{8}{}$ |
| 18 | ,003125 |
| 19 | ,0032986$\frac{1}{}$ |
| 20 | ,003472 |
| 21 | ,0036458$\frac{3}{}$ |
| 22 | ,0038194 |
| 23 | ,0039930$\frac{5}{}$ |

EXPLA-

## *EXPLANATION.*

Here, as in the former *Table* of *Money*, each *Decimal* is carried on till it either *terminates* or *repeats*, which you may perceive by the mark'd *Figures*, 3, 6, &c. for which Reason they are frequently continued to 7 or 8 Places, tho' ordinarily 3 or 4 would do; but as it so happens, that in the *Grains* especially, they don't circulate till the 8th Place, they are for that Reason continued so far: In some Places they are continued but to the 5th Place, the Reason whereof is, that there they either terminate or begin to repeat, and are so marked. The *Use* of this *Table* is the same in *Troy-Weight* as the former was in *Money*, as appears by the following *Example*, viz.

*Oz. Dwts Grs.*

*What is the* Decimal *to* 9 : 13 : 17 Troy?

Anſ. ,75 - - - for 9 *Ounces.*
,05416 for 13 *Penny-Weights.*
and ,00295138 for 17 *Grains.*

The Total ,80711803 is the *Decimal* to the Whole, as you may try by turning the *Oz. Dwts. Grs.* given Quantity 9 : 13 : 17 into a Vulgar *Fraction*; and then 'twill be $\frac{14822}{17760}$, whose *Decimal* is ,80711805, as above. The same is to be obſerv'd of all others.

*Avoirdupoiſe Weight.* One Hundred the *Integer.*

| Drams. | Decimals. | Ounces. | Decimals. |
|---|---|---|---|
| 1 | ,00003488 | 1 | ,00055803 |
| 2 | ,00006975 | 2 | ,00111607 |
| 3 | ,00010463 | 3 | ,00167411 |
| 4 | ,00013950 | 4 | ,00223214 |
| 5 | ,00017438 | 5 | ,00279017 |
| 6 | ,00020926 | 6 | ,00334821 |
| 7 | ,00024414 | 7 | ,00390625 |
| 8 | ,00027902 | 8 | ,00446428 |
| 9 | ,00031390 | 9 | ,00502232 |
| 10 | ,00034878 | 10 | ,00558035 |
| 11 | ,00038365 | 11 | ,00613839 |
| 12 | ,00041853 | 12 | ,00669642 |
| 13 | ,00045341 | 13 | ,00725445 |
| 14 | ,00048828 | 14 | ,00781249 |
| 15 | ,00052315 | 15 | ,00837053 |

*Avoir-*

*Avoirdupoise Weight.* One Hundred the *Integer.*

| Pounds. | Decimals. |
|---|---|
| 1 | ,00892857 |
| 2 | ,01785715 |
| 3 | ,02678572 |
| 4 | ,03571430 |
| 5 | ,04464287 |
| 6 | ,05357145 |
| 7 | ,0625.... |
| 8 | ,07142857 |
| 9 | ,08035715 |
| 10 | ,08928572 |
| 11 | ,09821430 |
| 12 | ,10714287 |
| 13 | ,11607145 |
| 14 | ,125..... |
| 15 | ,13392857 |
| 16 | ,14285715 |
| 17 | ,15178572 |
| 18 | ,16071430 |
| 19 | ,16964287 |
| 20 | ,17857134 |
| 21 | ,1875.... |
| 22 | ,19642857 |
| 23 | ,20535715 |
| 24 | ,21428572 |
| 25 | ,22321430 |
| 26 | ,23214287 |
| 27 | ,24107145 |

| Quarters. | Decimals. |
|---|---|
| 1 | ,25 |
| 2 | ,5 |
| 3 | ,75 |

One Pound the *Integer.*

| Drams. | Decimals. |
|---|---|
| 1 | ,00390625 |
| 2 | ,0078125. |
| 3 | ,01171875 |
| 4 | ,015625... |
| 5 | ,01953125 |
| 6 | ,0234375. |
| 7 | ,02734375 |
| 8 | ,03125.... |
| 9 | ,03515625 |
| 10 | ,0390625. |
| 11 | ,04296875 |
| 12 | ,046875... |
| 13 | ,05078125 |
| 14 | ,0546875. |
| 15 | ,05859375 |

| Ounces. | Decimals. |
|---|---|
| 1 | ,0625 |
| 2 | ,125. |
| 3 | ,1875 |
| 4 | ,25... |
| 5 | ,3125 |
| 6 | ,375. |
| 7 | ,4375 |
| 8 | ,5.... |
| 9 | ,5625 |
| 10 | ,625. |
| 11 | ,6875 |
| 12 | ,75... |
| 13 | ,8125 |
| 14 | ,8750 |
| 15 | ,9375 |

## *EXPLANATION.*

Here in these *Tables*, first one *Hundred Weight*, or 112lb. is made the *Integer*, and the *Decimal* is carried to eight Places for the Sake of Exactness; but 1 *Dram* coming out, only an *Approximate* is put down the nearest to the *Truth*, sometimes a small Matter too much, and sometimes too little;

little, and now and then corrected to make it ſtill more exact, becauſe the *Decimal* for 1 *Dram* is taken a little too big. In the *ſecond Table*, a Pound *Avoirdupoiſe* is made the *Integer*, of which a *Dram* being an even *Aliquot Part*, comes out exactly to ,00390625, which is a perfect *Decimal*: So that the *Drams* and *Ounces* are all of them perfect or terminate *Decimals*. In moſt Buſineſſes a *C.* is the higheſt Name made uſe of, and therefore 'tis here made the higheſt *Integer*; but if you would convert any of theſe *Decimals* into Parts of a *Ton*, 'tis but dividing the *Decimal* here ſet down, in the firſt *Table*, by 20, and your Work is done.

In the ſame Manner you may calculate *Tables* of other *Weights*, and of any Sorts of *Meaſures*, &c. I ſhall now proceed to ſhew you how to make or calculate ſmall *Tables*, by which you may compute the Value of any *Quantity* of *Goods* whatever, let the Name or Species of them be what they will.

*Firſt turn the Price or Value of one Thing, let it be* Meaſure, Weight, *&c. into a* Decimal *by the* Table *of* Coin *before ſet down*, Page 205, *and then multiply that* Decimal *according to the* Rules *given in* Multiplication *of* Decimals, *by the ſeveral Digits*, viz. 1, 2, 3, 4, 5, 6, 7, 8, *and* 9; *and thoſe ſeveral Products ſhall be the Amount of ſo many* Yards, Pounds, Hundreds, Pieces, *&c. at that Rate: And if you want the Value of* 10, 20, 30, 40, &c. *or* 100, 200, 300, 400, &c. *or* 1000, 2000, 3000, 4000, &c. *you have nothing more to do but to ſet the ſeparating Point*, 1, 2, 3, 4, &c. *Places more towards the* Right-hand *of your* Tabular *Product, and all the Places on the* Left-hand *of the ſeparating Point will be Pounds* Sterling, *and the remaining Parts towards the* Right-hand *will be the* Decimal *of a Pound* Sterling.

## *EXAMPLE.*

*Suppoſe I would know the Price of any Number of Things at* 4*s.* 9*d. each.* By the Table, Page 205, I find the *Decimal* of this *Sum* to be ,2375, which being ſet down and *multiply'd* by the ſeveral *Digits*, the *Products* will be as you ſee in the *Margin*; to uſe which, ſuppoſe the following *Queſtion* was aſk'd,

| | |
|---|---|
| 1 | ,2375 |
| 2 | ,475. |
| 3 | ,7125 |
| 4 | ,95.. |
| 5 | 1,1875 |
| 6 | 1,425. |
| 7 | 1,6625 |
| 8 | 1,9... |
| 9 | 2,1375 |

*What is the Amount of* 670 *Yards, Gallons, Buſhels, Pounds, &c. of any Thing, at* 4*s.* 9*d. per Yard, Gallon, Buſhel, Pound,* &c?

First look for 6, and ſet down the *Figures* 1425 belonging thereto; and becauſe the *Queſtion* is *Hundreds*, I make the Point, two *Figures* more towards the *Right-hand*, than it ſtands in the *Table*; thus - - 142,5
then I look for the 7, and becauſe the *Number* is 70, I put the Point 1 *Figure* forward; thus - - 16,625
add theſe together, and they make 159,225, or 159 *Pounds* 4 *Shillings* and 6 *Pence*. In like Manner may any other Number be done. As, *L.* 159,225

## *EXAMPLE* 2.

*What comes* 1358 *Buſhels of* Wheat *to, at* 4*s.* 9*d. per Buſhel?*

| *Value* | | *Quantity* |
|---|---|---|
| 237,5 | = | 1000 |
| 71,25 | = | 300 |
| 11,875 | = | 50 |
| 1,9 | = | 8 |
| 322,525 | = | 1358 |

*Anſ. L.* 322 : 10 : 6, as appears by the *Work* in the *Margin*. And ſo in like Manner for any other *Quantity*, great or ſmall, at this Price.

The like may done for any other Rate or Price, great or ſmall, by only calculating ſuch a ſmall *Table* at the fix'd *Price*. As, ſuppoſe 'twas *L.* 12 : 12 : 6. A *Table* made for this *Price*, will be as here under.

| | |
|---|---|
| 1 | 12.625 |
| 2 | 25.25. |
| 3 | 37.875 |
| 4 | 50.5.. |
| 5 | 63.125 |
| 6 | 75.75. |
| 7 | 88.375 |
| 8 | 101.... |
| 9 | 113.625 |

## *EXAMPLE.*

*If I buy* 113 *Hogſheads of Wine, at L.* 12 : 12 : 6 *per Hogſhead, What is the Amount?* Anſ. *L.* 1426 : 12 : 6, *as per Work* hereunto annexed plainly appears.

| *Value* | | *Quantity* |
|---|---|---|
| 1262,5 | = | 100 |
| 126,25 | = | 10 |
| 37,875 | = | 3 |
| Total 1426,625 | = | 113 |

Again,

Again, Suppoſe the Price 16 *d.* ½, the Table will be — — —

| | |
|---|---|
| 1 | ,0677083. |
| 2 | ,1354166 |
| 3 | ,203125. |
| 4 | ,2708333 |
| 5 | ,3385416 |
| 6 | ,40625. |
| 7 | ,4739583 |
| 8 | ,5416666 |
| 9 | ,609375. |

*EXAMPLE.*

*What is the Value of* 13618 *Yards of* Iriſh Linen, *at* 16 *d.* ½ *per Yard?* Anſwer, *L.* 922 : 1 : 00 ½, as appears by the following Work.

| *Value* | | *Quantity* |
|---|---|---|
| 677,0833 | = | 10,000 |
| 203,125. | = | 3,000 |
| 40,625. | = | ,600 |
| ,677. | = | 10 |
| ,5416 | = | 8 |
| 922,0520 | = | 13,618. |

I preſume enough has been ſaid upon this Subject to make it entirely plain, from whence any Body may calculate ſuch *Tables* as the ſeveral *Commodities* they deal in may require, with very little Trouble and great Certainty, and ſo have them always ready for Uſe. We ſhall now go on to ſhew the Uſe of both *Vulgar* and *Decimal Fractions*, in the ſeveral *Rules* uſed in *Trade* and *Buſineſs*, together with the Method of computing *Tables* of *Intereſt*, and *Rebate*, both *Simple* and *Compound*.

## CHAP. VIII.

### *Containing the Rule of* PRACTICE, *wrought after ſeveral different Manners.*

PRACTICE is that *Rule*, by which *Merchants* commonly caſt up the *Value* of their ſeveral *Commodities*, and is in Effect only a compendious or ſhort Way of performing the *Rule of Three*.

In this *Rule*, the *Price* or *Value* of one *Thing* is given, to find the *Price* or *Value* of many.

In order to perform which, diverſe *Methods* have been invented; and indeed the Number of *Caſes* are ſo many and ſo variable, that though one *Univerſal Method* may be laid down, that will Anſwer all *Caſes*, yet that *Method* will not always be the ſhorteſt, nor indeed, in many *Caſes*, the beſt. Therefore I will ſhew you two *General Methods*, by which all *Queſtions* may be wrought; the one by *Decimals*, the other by *common Numbers*; and alſo the beſt particular *Methods* for working any Propoſition both Ways; by which you will gain not only a Readineſs in the Execution of any Thing that is to be done by this *Rule*, but alſo be aſſured of the *Truth* and *Certainty* of what you do.

Note, *Whatever your Species of Goods are, whether* Horſes, Sheep, Cloth, Grain, *or any other* Commodity, *you muſt imagine them to be chang'd or converted into ſo many* Pieces *or* Sums *of* Money, *as is the* Price *or* Rate *of one given Thing, whether it be* Pound, Yard, Buſhel, Carcaſe, *&c.* As for Inſtance, Suppoſe I aſk, What is the *Value* of 265 *Ells* of *Holland* at 5*s.* per *Ell?* This is all one, as if I aſk'd, What comes 265 *Crowns* to? So in like Manner, if I aſk, What comes 95 *Sheep* to, at 27 *Shillings* per *Sheep?* 'tis the ſame Thing as if I had aſk'd, How many *Pounds Sterling* are there in 95 *Moidores?* In like Manner, if I aſk, What is the Amount of 195 *Truſſes* of *Straw*, at 9 *Pence* per *Truſs?* 'tis the ſame Thing as aſking, What comes 195 *Nine-pences* to? And ſo in all other *Caſes*, whether the Price be above or under a *Pound* Sterling.

*The firſt General Rule for all Caſes and all Prices.*

1. If the given *Price* be under a Pound *Sterling*; find the *Decimal* for that *Sum*, and *multiply* it by the Quantity, or the Quantity by it, and the Product is the Anſwer ſought.

2. If the *Price* given be whole *Pounds* only; *multiply* the *Quantity* by thoſe *Pounds*, or thoſe *Pounds* by the *Quantity*, as you ſhall think beſt, and the *Product* will be the Anſwer ſought.

3. If the *Price* given be one or more *Pounds*, and ſome *Shillings*, *Pence*, or *Farthings*; find the *Decimal* to the odd *Money*, and *add* the *Pound*, or *Pounds* Sterling given, to it, and then either *multiply* the *Quantity* by the ſaid mix'd Number that repreſents the *Price*, or the ſaid *Price* by the *Quantity*, as is moſt convenient, and the *Product* will be the Anſwer ſought; as appears by the following

## EXAMPLES.

*At* 4 *s. a Pair, What comes* — 316
*Pair of Stockings to?* — — ,2
The *Decimal* to 4 *s.* is ,2, by which I *multiply* the whole *Quantity* given, and the *Product* is 63,2, whose Value is 63 *Pounds* and 4 *Shillings*, according to the *Rule* given you, Page 203, to find the *Value* of a *Decimal* in the known Parts of a *Pound* Sterling, by Inspection. 63,2

*What comes* 718 *Pair of Shoes to, at* 5 *s.* 6 *d. a Pair?*

718 Shoes.
,275 *Decimal to* 5 *s.* 6 *d.*

3590
5026
1436

The *Decimal* to 5 *s.* 6 *d.* is 275, and the *Product* is, 197,450

Or, *L.* 197 : 9 : —

*What comes* 3156 *Yards of* Irish-Linen *to, at* 18 *d.* ½ *per Yard?*

The *Decimal* to 18 ½ is ,077083
The *Quantity* is — 3156

462499
3854166
7708333
231249999

The *Product* is — 243,275000

Or, *L.* 243 : 05 : 6

But the last *Example*, and all others under the like Circumstances, may be shortned by the *Rule* of *contracting Multiplication*, given you, Page 183.

Note, *In all such* Cases *as these, three Places of* Decimals *are sufficient to keep in the* Product; *and therefore you may set down the last Work as follows,*

,077083

,077083
6513

231250
7708
3854
463

243,275

Here the *Product* is 275 in the *Decimal*, which by the *Rule*, Page 203 comes to 5 *s.* 6 *d.*

## More *EXAMPLES.*

*At* 1 *d.* ¼ *per* Yard, *What comes* 38 Pieces *of* Ferret *to, each* 36 Yards?

36
38

288
108

1368 *Yards* in all.
,0052083 *Decimal* to 1 *d.* ¼.

.416666
3124999
15624999
52083333

7,125.... Or *L.* 7 : 2 : 6

Or thus contracted.

,0052083
8631

..5208
..1563
312
42

7,125. as above.

In this, and such like *Contractions*, as there is much Labour sav'd, so there is some *Judgment* required; for in the second

ſecond *Line*, in *multiplying* by 3, I take 3 for the foregoing Carriage, tho' the *Product* immediately before it comes to but 24, becauſe the *Figure* before it is a *Repetend*, which if *multiply'd*, would have made it 25; but I carry 0 the next Time when I *multiply* by 6, though the 0 would have 5 for its *Product*, if the whole *Line* was *multiply'd*; ſo that this ſets it even by taking $\frac{1}{4}$ an *Unit* too much one Time, and $\frac{1}{2}$ too little the other Time.

*At* 3 Farthings *a Piece, What comes* 4617 Oranges *to?*

*Anſ. L.* 14 : 8 : 6$\frac{1}{4}$.

You may *contract* this, but the *Figures* ſav'd, being but few, I work it at large.

4617
,003125

23085
9234.
4617..
13851...

14,428125

*At* 11 *d.* $\frac{1}{4}$ *per* Pint, *What comes* 27 Pipes *of* Wine *to?*

1008 *Pints* in a *Pipe.*

216
27..

27216 *Pints* in all.

This Work is contracted, and the *Anſwer* is, *L.* 1275 : 15.

*Decimal.*
,046875 to 11 *d.* $\frac{1}{4}$
61272

937500
328125
9375
469
281

1275,750

Here are only 3 *Decimal* Places reſerv'd in the *Product*, and therefore the *Units* Place of the *Multiplier* is put under the 6, which is the third *Place* of the *Multiplicand*; and becauſe the *Mutiplier* conſiſts altogether of whole *Numbers*, they are ſet even beyond the *Multiplicand*; and in ſuch Caſe thoſe *Places* are always ſuppoſed to be ſupply'd by *Cyphers* or 0's.

*At*

*At* 13 *s.* 3 *d.* ½ *per Piece, What comes* 968 *Pieces to?* Anſ. *L.* 643 : 6 : 4.

13 *s.* 3 *d.* ½ is ,664583 in *Decimals.*
869 *Pieces* inverted.

598125
39875
5317

*Product* is 643,317 Or *L.*643 : 6 : 4.

Three Places of *Decimals* being ſufficient to keep in the *Product*, I put the *Units* Place of the *Multiplier* under the 4, and work as before; and parting off 3 *Figures*, towards the *Right-hand* of the *Product*, all the other *Figures* towards the *Left-hand* are whole *Numbers*.

*In* 716 Moidores, *each* 27 Shillings, *How many Pounds* Sterling?

716 *Moidores.*
1,35 the *Decimal* to 27 *Shillings*, *L.* 966, 60;
or,
3580 Anſ. *L.* 966 : 12 : —
2148.
716..
966,60

*In* 849 Portugal *Pieces of Gold*, *Value* 36 Shillings *each*, *How many Pounds* Sterling?

849 *Pieces.*
1,8 the *Decimal* to 36 *Shillings.*
6792
849.
1528.2 Anſ. *L.* 1528 : 4 : —

*In*

*In* 629 Portugal *Pieces of* Gold, *Value* L. 3 : 12 *s. each, How many Pounds* Sterling?

629 Pieces of *L.* 3 : 12 each.
3,6 the *Decimal* to *L.* 3 : 12.

3774
1887

*Product* 2264,4 Or *L.* 2264 : 8.

*In* 1629 *Pieces of* Portugal *Gold, Value* 4 *s.* 6 *d. each, How many Pounds?*

1629 *Pieces.*
,225 *Decimal* to 4 *s.* 6 *d.*

8145
3258.
3258..

366,525 Anſ. *L.* 366 : 10 : 6.

*In* 519 *Pieces of* Portugal *Gold, Value* 9 Shillings *each, How many Pounds* Sterling?

519 Pieces.
,45 *Decimal* to 9 Shillings.

2595
2076.

233,55 Anſwer, *L.* 233 : 11 : —

*Bought* 365 *Quarters of Malt at* L. 1 : 3 : 6 *per Quarter, What come they all to?*

365 *Quarters.*
1,175 the *Decimal* to *L.* 1 : 3 : 6.

5875
7050.
3525..

Here I *multiply* by the upper *Number.*

428,875 Anſwer, *L.* 428 : 17 : 6.

*At* L. 8 : 7 : 11 *a Piece, What come* 95 *Oxen to?* Anſ. *L.* 797 : 12 : 1.

| | *l.* | *s.* | *d.* |
|---|---|---|---|
| 8,39583 *Decimal* to | 8 | 7 | 11 |
| 59 Oxen. | | | |
| 755625 | | | |
| 41979 | | | |
| *Product* 797,604 equal to *L.* 797 | 12 | 1. | |

the 95 is inverted and the Work is contracted.

*If I have* 5 *Wedges of Gold, that weigh* 27 lb. 9 Oz. 11 Dwt. 17 Gr. *worth* L. 3 : 19 : 10 ½ per *Oz. What is the Whole worth?* Anſwer, L. 1332 : 5 : 1 ¼.

| *Oz. Decimals.* |
|---|
| 333,585416 |
| 573993 |
| 1000756 |
| 309227 |
| 30023 |
| 1092 |
| 234 |
| 16 |
| 1332,257 |

You will obſerve, that in *multiplying* the 3d Line, or 2d 9, I carry 8, becauſe if the proper Allowance was added to the foregoing 8, 'twould come to 78; and in *multiplying* by the 7, if the due Allowance was made to the foregoing 3, 'twould come to 25. You will alſo obſerve, that I bring the *Pounds Troy-Weight*, into *Ounces*, and make an *Ounce* the *Integer*, and ſo take the *Decimal* Parts of 11 *Dwts.* 17 *Gra.* only; but you may *multiply* the given *Price* of the *Ounce* by 12, and ſo reckon a *Pound Troy-Weight* for the *Integer*, and take the *Decimal* for 9 *Ounces* 11 *Dwts.* 17 *Grains*, as is done below.

*L.* 3 : 19 : 10 ½ the *Value* of one *Ounce.*
12

47 : 18 : 6 *ditto* of twelve *Oz.* or 1 lb.

lb's.

lbs. and *Decimal* *Oz. Dwts. Gra.* [*Integer*,
27,798784 , of 9 : 11 : 17 a lb. *Troy* being the
529,74 - - is the inverted Value of 1 lb. *viz.*
of *L.* 47 and 925 the *Decim.* of
18*s.* 6*d.* whose *Product* comes to
the same with the former, as
appears by the Work; and
which is an infallible Proof that
both Operations are truly
wrought.

Here you may plainly see the Usefulness of these *Contractions*, for if the two last *Examples* had been wrought at large, they would have stood thus:

The first *Operation* of the last *Question* wrought at large.

*Oz. Decimal* Parts. *Dwts. Gra.*
333,585416 of 11 : 17
3,99375 = *L.* 3 : 19 : 10 ½.

16|67 927083
233|50 979166
1000|75 624999
30022|68 749999
300226|87 499999
1000756|24 999999

1332,256|7 5781250

Here you see all the *Figures* on the *Right-hand* of the *Line* are left out in the *Contraction*, and the *Product* of the *Contraction* is only ¼ of the 3d *Figure* bigger than the Work at large, or about the ¼ Part of a *Farthing* in Value.

*The second Operation of the same Example at large.*

lb. *Decimal* Parts *Oz. Dwts. Gra.*
27,798784 of 9 : 11 : 17
47,925 of *L.* 47 : 18 : 6

1389|93920
5559|7568..
250189|056..
19459|1488...
1111|95136....

1332,256|723200

In the ſecond *Operation* at large, you perceive that the *Product* is the ſame with the firſt, to the fifth Place of *Decimals*, where it differs; which Difference ariſes from the Parts of the *Ounce* being a *Repetend*, and work'd ſo; *whereas* the other is only an *Approximate*, which occaſions the Anſwer to be about the $\frac{4}{10}$ Part of a *Farthing* leſs in Value than the other.

All other *Examples* whatever, anſwerable by this *Rule*, are wrought after ſome of the foregoing Methods; ſo that I will not repeat any more to be wrought by *Decimals*, but propoſe the ſame Queſtions again to be wrought by

*The ſecond* General Rule *or* Method *for working* Practice *in common Numbers.*

Here 'twill be proper to bring the given *Price* into the loweſt *Name* mentioned, and *multiply* the *Price* (ſo reduced) by the given *Quantity*, and the *Product* will be the *Anſwer* to the *Queſtion* in the *Name* you reduced your *Price* to, which muſt be brought into *Pounds*, *Shillings*, *Pence*, &c. as Occaſion may require.

*EXAMPLES.*

Queſt. 1. *At* 4*s. a Pair, What comes* 316 Pair of Stockings to?
4 *Shill. Price* of 1 Pair.

2 | 0 | 126 | 4 whole *Value* in *Shill.*

*L.* 63 : 4 Anſ. as in Page 213.

Q. 2. *What comes* 718 *Pair of Shoes to, at* 5 *s.* 6*d. a Pair?*

11 2

718
718 11 Sixpences.

4 | 0 | 789 | 8 the *Anſwer* in Sixpences.

*L.* 197 | 9, as before in Page 213.

*Note*, When the given Price is 6*d.* 4*d.* 3*d*, &c. as 5*s.* 6*d.* 7*s.* 4*d.* or 8*s.* 3*d*, &c. you need not bring the *Money* into *Pence*, but *Six-pences*, *Groats*, *Three-pences*, &c. as you will find done in ſome of the following *Queſtions.*

Q. 3.

Q. 3. *What comes* 3156 *Yards of* Iriſh Linen *to, at* 18 *d.* ½ *per Yard?* 37 Price of 1 Yd. in Halfpence 2

22092
9468.

2 | 116772 *Price* of the Whole in *Halfpence.*

12|58386 *Price* in *Pence.*

2|0|486|5 : 6 *Price* in *Shillings.*

*L.* 243 : 5 : 6 Anſwer, as in Page 213.

37 ½ *Pence*

Q. 4. *At* 1 *d.* ¼ *per Yd, What comes* 38 *Pieces of* Ferret *to, each* 36 *Yards?*

4 — 5 *Farthings.*

36 — 228 — 114

1368 *Yards* in all the *Pieces.*
5 *Farthings* that a *Yd.* coſt.

4 | 6840 *Value* of whole in *Far.*

12 | 1710 ditto in *Pence.*

2|0 | 14|2 : 6 ditto in *Shill. Pence.*

Anſwer, *L.* 7 : 2 : 6, as in Page 214.

Q. 5. *At* ¼ *d. a Piece, What comes* 4617 *Oranges to?*
3 *Farth. Price of* 1 Orange.

4 | 13851 *Farthings* all coſt.

12|3462 : 3 *Pence* and *Farthings.*

2|0|288 : 6 *Shillings* and *Pence.*

Anſwer, 14 : 8 : 6 ¼, as in Page 215.

Q. 6.

Q. 6. *At* 11 ¼ *d. a Pint, What comes* 27 *Pipes of Wine to?*

4 — 1068 *Pints* in a *Pipe.*

45 — 216

4 | 1224720 — 2700

12 | 306180 — 27216 *Pints* in 27 Pipes.

45 Coſt of a *Pint* in *Far.*

2 | 0|255|15 — 136080

Anſwer *L.* 1275:15 — 108864

as before in Page 215. — 1224720 Value of the whole in *Farthings.*

*s. d.*

Q. 7. *At* 13 : 3 ½ per *Piece, What comes* 968 *Pieces to?*

12 — 968

1592 *Pence.* — 319 *Value* of 1 in ½ *d.*

319 *Half-pence.* — 8712

968.

2904..

2 | 308792 *Value* of all in ½ d.

12 | 154396 *Pence.*

2 | 0|12861 6 : 4 *Shillings* and *Pence.*

Anſwer, *L.* 643:06:4, as in Page 216.

Q. 8. *What comes* 716 Moidores *to, at* 27 Shillings *per* Moidore?

27

5012

1432

2 | 0 | 1933 | 2 *Shillings.*

*L.* 966 : 12, as before in Page 216.

Q. 9.

Q. 9. *What comes* 849 Portugal *Pieces of Gold to at* 36*s. each?*
36 *Shillings* in one *Piece.*

5094
2547.

2 | 0|3056|4 *Shillings* in all.

Anſwer, *L.* 1528:4, as before in Page 216.

Q. 10. *What comes* 629 Portugal *Pieces of Gold to at* L. 3:12?
Shillings in 1 *Piece* 72 20

1258
4403

2 | 0 | 45288 Shillings in all.

Anſwer, *L.* 2264:8, as before in Page 217.

Q. 11. 1629 *Pieces at* 4*s.* 6*d. each?*
9 2

4|0 | 1466.1 9 Six-pences.

L. 366:10:6, as before in Page 217.

Q. 12. 519 *Pieces, at* 9 *Shillings each?*
9

2 | 0|467|1

L. 233:11, as before in Page 217.

Q. 13.

Q. 13. — 365 *Quarters* of Malt *at* L. 1 : 3 : 6 *per Quarter?*
47 Six-pences 1 Qr. coſt. 40

2555 — 47 *Six-pences.*
1460

40 | 171515 Six-pences the Whole coſt.

L. 428:17:6, as before, Page 217.

Q. 14. — 95 *Oxen* at *L.* 8 : 7 : 11 *each?*
20

167
12

2015 *Pence* one *Ox* coſt.
95 the Number of *Oxen.*

10075
18135

12 | 191425 *Pence* all coſt.

20 | 1595|2 : 1

| *L.*797 : 12 : 1, as before, Page 218.

I have gone thus far to ſhew the Agreement of theſe two *General Methods*, from whence you may make ſome ſort of a Concluſion, which to prefer; but as this *Rule* is commonly wrought, by ſuppoſing the *Integer*, and the *Price* given managed ſo as to make it *one*, *two* or more *Parts* of the ſaid *Pound*, 'twill be proper to ſet down the following *Table*, which contains the ſeveral *Aliquot Parts* both of a *Pound* and a *Shilling*.

| *s.* | *d.* | |
|---|---|---|
| 10 : | — | is $\frac{1}{2}$ of a Pound *Sterling*. |
| 6 : | 8 | — $\frac{1}{3}$ |
| 5 - | - - | $\frac{1}{4}$ |
| 4 - | - - | $\frac{1}{5}$ |
| 3 : | 4 - | $\frac{1}{6}$ |
| 2 : | 6 - | $\frac{1}{8}$ |
| 2 : | — - | $\frac{1}{10}$ |
| 1 : | 8 - - | $\frac{1}{12}$ |
| 1 : | 4 - - | $\frac{1}{15}$ |
| 1 : | 3 - - | $\frac{1}{16}$ |
| 1 : | — - | $\frac{1}{20}$ |

| *d.* | *Far.* | |
|---|---|---|
| — | 1 | is $\frac{1}{4}$ of a *Penny*. |
| — | 2 | is $\frac{1}{2}$ |
| — | 3 | is $\frac{1}{16}$ of a Shilling. |
| 1 - | - - | $\frac{1}{12}$ |
| 1 $\frac{1}{2}$ | - - | $\frac{1}{8}$ |
| 2 | - - - | $\frac{1}{6}$ |
| 3 | - - - | $\frac{1}{4}$ |
| 4 | - - - | $\frac{1}{3}$ |
| 6 | - - - | $\frac{1}{2}$ |

As *Avoirdupoiſe Weight* is that which is us'd for *Sugar*, *Tobacco*, all Sorts of *Drugs*, &c. and the *C.* Weight is the general *Integer*, I will ſet down the *Aliquot Parts* of a *C.* and a *Quarter*.

| *Quar.* | |
|---|---|
| 2 | is $\frac{1}{2}$ of *C.* |
| 1 - | $\frac{1}{4}$ |
| lb. | |
| 16 - | $\frac{1}{7}$ of *C.* |
| 14 - | $\frac{1}{8}$ |
| 8 - | $\frac{1}{14}$ |
| 7 - | $\frac{1}{16}$ |

| lb. | |
|---|---|
| 1 | is $\frac{1}{28}$ of a *Quarter* of *C.* |
| 2 - | $\frac{1}{14}$ |
| 4 - | $\frac{1}{7}$ |
| 7 - | $\frac{1}{4}$ |
| 14 - | $\frac{1}{2}$ |

By the two foregoing General *Methods* any *Queſtion* whatever may be wrought, belonging to this *Rule*; but as *Merchants* and other great *Traders* generally work their *Queſtions*, or caſt up the *Value* of their *Commodities*, by ſuppoſing the *Quantities* of their Goods to be ſo many *Pounds* Sterling, when the given Price is above a *Shilling*, and conſequently the *Amount* or *Value* thereof more or leſs, as the *Price* of 1 is nearer to, or farther from a *Pound:* And accordingly they take one or more Parts of a *Pound*, as the *Price* may happen to be: But if the given *Price* is under a *Shilling*; then a *Shilling* or *Six-pence* is generally made the *Integer*, and the Parts taken in Proportion thereto, as you will ſee in ſeveral of the following *Examples*. And indeed the Variety of Ways the Prices may be taken, or the Number of Times it may be varied are ſo many, that it is impoſſible to lay down any poſitive determinate *Rule* for the breaking the given *Price* into Parts; but every one muſt be left to his own Choice

and Judgment: Only I will give ſeveral *Examples* done in different *Methods*, that the Learner may ſee what is or may be done; and 'till *Experience* ripens his *Judgment*, ſo as to vary or alter, as the Caſe may require, how he may do in any ſuch like Caſes. And firſt, I will repeat the foregoing *Queſtions* again, that ſo by comparing ſo many different *Methods* together, he may form a *Judgment*, which is beſt, and when one Way, and when the other may be moſt *expeditious*; for in *Buſineſs*, where People have a great deal of Work to do in a little Time, the *ſhorteſt*, *plaineſt* and *eaſieſt* Way muſt certainly be the *beſt*.

Bought *EXAMPLE* 1.

4*s.* is $\frac{1}{5}$ L. 316 *Pair of* Stockings *at* 4 *s. per Pair?*

Anſ. *L.* 63 : 4. as in Pages 213 and 220.

Here you may obſerve that the whole *Quantity* bought, *viz.* the 316 *Pair*, are ſuppos'd to be 316 *Pounds*; but as 1 *Pair* coſt but 4 *s.* and 4 *s.* is but the $\frac{1}{5}$ of a *Pound*, conſequently the *Value* of the Whole can be but $\frac{1}{5}$ of 316 *Pounds*; therefore dividing by 5, the *Quotient* or *Anſwer* is 63 and $\frac{1}{5}$; but $\frac{1}{5}$ being 4 *s.* the compleat *Anſwer* is *L.* 63 : 4, as before.

Sold. *EXAMPLE* 2.

718 *Pair of* Shoes *at* 5 *s.* 6*d.* per *Pair?*

5 *s.* is $\frac{1}{4}$ *L.* | 179 : 10, the Amount at 5 *s. per* Pair.
6 *d.* is $\frac{1}{10}$ 5*s.* | 17 : 19 Ditto - - at 6*d.* Ditto.

Total *L.* 197 : 9 as before, Pages 213 and 220.

Here (as before) the Whole is ſuppoſed to be *Pounds* Sterling, but as 5 *s.* 6*d.* is far ſhort of a *Pound*, ſo the *Value* or *Amount* of the Whole muſt alſo come proportionally ſhort of *L.* 718 *Pounds*; but 5 *s.* 6 *d.* in one Sum is no *Aliquot Part* of a *Pound*, therefore I muſt take it at *twice* or *thrice*, &c. as is moſt commodious: And therefore I take it at *twice*, *viz.* firſt I ſay, 5 *s.* is the $\frac{1}{4}$th of a *Pound*, and divide the 718 by 4 accordingly, and find the *Quotient* or *Anſwer* come to L. 179, and 2 remains, which are $\frac{2}{4}$ or $\frac{1}{2}$ of a *Pound* Sterling, which is 10 *Shillings*, as you ſee ſet down in the Work of the laſt *Example*: Then ſay, 6 *Pence* is $\frac{1}{10}$ of 5 *Shillings*, and therefore I divide the *L.* 179 : 10 by 10, and the *Anſwer*

or

or *Quotient* is *L.* 17 : 19; which two Lines being *added* together make *L.* 197 : 9, as before, by the two *General Methods*, Pages 213 and 220.

Bought *EXAMPLE* 3.

3156 *Yards of* Iriſh Linen at 18 *d.* ½ *per* Yard.

1*s.* is $\frac{1}{20}$ *L.* 157 : 16
6*d.* is ½ *Shil.* 78 : 18
½ is $\frac{1}{12}$ of 6*d.* 6 : 11 : 6

1 : 6 ½ *L.* 243 : 5 : 6, as before, Pages 213 and 221.

Here I am forced to take the *Parts* at three *Times*, viz. firſt 1 *Shilling*, for which I take $\frac{1}{20}$ Part of the whole Number of *Yards*, they being imagined to be turned into *Pounds*; then 6 *Pence* being the Half of a *Shilling*, I *divide L.* 157 : 16 by 2, and ſet *L.* 78 : 18, the *Quotient* found, under it; and then ½ *d.* being $\frac{1}{12}$ of 6 *Pence*, I *divide L.* 78 : 18 by 12, and the *Quotient* comes out *L.* 6 : 11 : 6, which being put under the two foregoing *Sums*, the whole Amount is *L.* 243 : 5 : 6.

Note, *For the greater Certainty of knowing the Truth of your Work, 'twill be proper always to do your Queſtions twice over by different Methods; and if both the Totals agree, you may depend upon their being right.* As for Inſtance,

Set down the above Queſtion again, thus:

3156 *Yards at* 18 *d.* ½ per *Yard.*
1578
131 : 6
2 | 0 | 4865 : 6
L. 243 : 5 : 6

Here I ſuppoſe the firſt *Line* to be *Shillings*, then 6 *Pence* being ½ of a *Shilling*, I *divide* by 2, and ſet the *Quotient* under the firſt *Line*; then ½ *d.* being $\frac{1}{12}$ of 6*d.* I *divide* the ſecond *Line* by 12, and ſet down the *Quotient* ſo found under the former; then I *add* the three *Lines* together, and they make 4865 *Shillings* and *Sixpence*; I divide the *Shillings* by 20, and then they come to *L.* 243 : 5 : 6, as before.

## *EXAMPLE* 4.

Pieces *Ferret* *Yards* *d.*

38 each 36 at 1 ¼ per *Yard.*

36

228

114.

1368 *Yards* at 1 ¼ per *Yard.*

1*d.* is ½ *Shill.* 114

1 *Far.* ¼ *d.* .28 : 6

2 | 0 | 142 : 6

L. 7 : 2 : 6, as before, Pages 214 and 221.

Here the 1368 *Yards* are ſuppoſed to be *converted* into *Shillings*, then 1 *Penny* being the $\frac{1}{12}$ of a *Shilling*, the *whole* is *divided* by 12, and the *Quotient* is *Shillings*; the 1 *Farthing* being ¼ of a *Penny*, the *Line* that was found to be the *Value* of the *Penny* is *divided* by 4, and the *Quotient* 28 *s.* 6 *d.* being *added* to it, makes 142 *s.* 6*d.* and the *Shillings* divided by 20 gives *L.* 7 : 2 : 6 for the *Quotient* or *Anſwer.*

8 | 1368 *five Far.*

3 | 171 *Ten Pences.*

8 | 57 *half Crowns.*

*L.*7 : 2 : 6

Or you may ſet down the Yards and *divide* them by 8, and that will bring them into *Tenpences*; becauſe 8 *Times* 1 *d.* ¼ is 10 *Pence*; then 3 *Tenpences* is 2 *s.* 6 *d.* and 8 Times 2 *s.* 6 *d.* is one *Pound*; which being done, as in the *Margin*, the *Anſwer* is the ſame as before.

*Note*, Tho' in *Page* 224, you were told, that commonly the given *Quantities* of *Goods* were chang'd, or ſuppos'd to be converted into *Pounds* Sterling, yet when the *Price* is ſmall, as in the *Example* above, 'tis frequent to ſuppoſe the given *Quantities* to be *Pence*, *Shillings*, *Six-pences*, *Ten-pences*, *Half-Crowns*, or any other Sub-diviſion of a *Pound* Sterling, as you ſhall think moſt commodious for your preſent Purpoſe.

*E X-*

## *EXAMPLE* 5.

4617 *Oranges at* ¼ *d. per Orange?*

3 *Far.* ⅛ of 6*d.* 57|7 : ¼

6*d.* 1/40 of L. L. 14 : 8 ; 6¼

Or thus 4617 *Pence.*

2 *Far.* ½ *d.* 2308 : 2
1 *ditto* ½ 2 *F.* 1154 : 1

12 | 3462 : 3

2|0|28|8 : 6

*L.* 14:8 : 6¼

Here firſt, I ſuppoſe the *Oranges* ſo many *Six-pences*, and then I ſay, 3 *Farthings*, the real Price of 1 *Orange* is ⅛ Part of *Six-pence*, and divide by 8, to find the Value of the *Oranges* ſo changed into *Six-pences*; then I divide the *Six-pences* thus found by 40, becauſe ſo many *Six-pences* make a *Pound* Sterling; and the *Anſwer* comes out L. 14 : 8 : 6¼. In the ſecond Method I ſuppoſe the *Oranges* to be Pence, and ſay, 2 Farthings is ½ of a Penny, and divide by 2; the 1 Farthing is the ½ of 2, and divide that *Quotient* by 2; then ſetting the two *Quotients* under one another, and adding them together, their Sum is 3462 *Pence* 3 *Farthings*; the Pence divided by 12, brings them into Shillings, and the Shillings divided by 20 brings them into Pounds; ſo that the Whole comes to L. 14 : 8 : 6¼ both Ways, as in Pages 215 and 221.

Or you may do it thus:

4 | 4617
1154 : 1

30 | 346|2 : 3

8 | 115:1 : 0

*L.* 14:8 : 6¼

Here I conſider the given Quantity as Pence; but the Price being but 3 Farthings I divide by 4, which gives 1154 *Pence* 1 *Farthing*. This I ſubſtract from the ſaid 4617 *Pence*, and the Remainder is 3462 *Pence* and 3 *Farthings*; the *Pence* I divide by 30, and the *Quotient* is 115 half Crowns, and 12 Pence, or 1 Shilling over: The half Crowns I divide by 8, and the *Quotient* is 14 Pounds and 3 over, which is 3 *half Crowns*, or 7 Shillings and 6 Pence, and the Shilling over before, makes 8 Shillings and 6 Pence; ſo that the Whole is

*L.* 14 : 8 : 6 ¼, as before. And thus you may vary your Proceſs both to pleaſe and inform your ſelf; for if your Work be done right, the Anſwer will always come out the ſame, let the Method be what it will.

## *EXAMPLE* 6.

27 *Pipes of Wine* at 11 *d.* ¼ per *Pint.*
126 Gallons in a Pipe.

882
252

3402 Gallons.
8 Pints in a Gal.

*Six-pen.* 27216 Pints in all.
3*d.* ½ 6*d.* 13608
2*d.* ⅓ 6*d.* 9072
1 *F.* ⅛ 2*d.* 1134

4 | 0 | 51030 Total in Six-pences.

L. 1275 : 15 Anſ. as in Pages 215 and 222.

Or thus:

8 | 27216 Pints at 11 *d.* ¼.
3402 *Quot.* by 8. *Sub.*

23814 Rem. for 5d. ¼.

4 | 051030 Total for 11 ¼.

*L.* 1275 : 15

In working both theſe *Methods*, I ſuppoſe the 27216 *Pints* to be *Six-pences*, and in the firſt I *divide* them firſt by 2, becauſe 3 *Pence* is ½ *Six-pence*; then I *divide* them by 3, becauſe 2 *Pence* is ⅓ of *Six-pence*; then I *divide* the laſt *Quotient* by 8, becauſe 1 *Farthing* is the ⅛ of 2 *Pence*; then I add all together, and it makes 51030 *Six-pences*, which I divide by 40, to bring them into *Pounds*, and the Anſwer is L. 1275 : 15. In the ſecond *Method* I *divide* by 8, becauſe 3 *Farthings* is the ⅛ of 6 *Pence*, and ſubſtract that *Quotient* from the whole *Dividend*, and the Remainder is the Amount at 5 ¼ per *Pint*; this Remainder added to the *Dividend*, which is the Amount of the Whole in *Sixpences*, at 6*d.* per *Pint*, the *Sum* is 51030 *Sixpences*, which divided by 40 comes out as before.

*EX*

## EXAMPLE 7.

| | s. | d. |
|---|---|---|
| 10 *Shill.* 968 *Pieces at* | 13 : | 3 ½ *per* Piece. |
| 2 ½ 10s. | 193 : | 6 *s. d.* |
| 1 ½ 2s. | 96 : | 8 : — |
| 0 : 3 is ⅓ | 24 : | 2 : — |
| : ½ is ⅙ | 4 : | - : 4 |
| 13 : 3½ | 1286 : | 6 : 4 |
| *L.* | 643 : | 6 : 4 |

L. 968 *Pieces at* 13 : 3½.

| | | |
|---|---|---|
| 4 ⅕ L. | 198 : | 12 |
| 4 *ditto* | 193 : | 12 |
| 4 *ditto* | 193 : | 12 |
| 1 ½ of 5s. | 48 : | 08 |
| 0 : 3 ¼ | 15. | 12 : 02 |
| 0 : 0 ½ ⅛ | 3*d.* | 2 : 00 : 4 |
| 13 : 3½ | *L.* 643 : | 6 : 4 |

In the first Method the 968 Pieces are suppos'd so many 10 Shillings; the Parts are taken for 2*s.* 1*s.* 3*d.* and ½*d.* which being all added together, make 1286 ten Shillings, and 6*s.* 4*d.* the 1286 halved or *divided* by 2, gives L. 643 : 6 : 4. In the second *Method* the 968 *Pieces* are imagined to be *Pounds*; and 4*s.* being the ⅕ of a Pound, the Whole is divided by 5, and the *Quotient* L. 193 : 12, set down three Times to make 12 Shillings; then one of those Lines are divided by 4, because 1 Shilling is ¼ of 4 *Shillings*, and that last Quotient is also divided by 4, because 3*d.* is ¼ of a *Shilling*, and that last Quotient is divided by 6 because ½ *d.* is ⅛ of 3*d.* and the Sum of all these Quotients, in both Methods, amount to L. 643 : 6 : 4, as before, Pages 216 and 222.

## EXAMPLE 8.

| | | |
|---|---|---|
| 1 L. — | 716 *Moidores*, 27*s. each.* | |
| 5*s.* is ¼ L. | 179 | |
| 2 is ⅒ L. | 71 : 12 | |
| L. 1 : 7 | L. 966 : 12 | |

Here you see as the *Price* is above L. so the *Amount* comes to so much more than the L's. which is suppos'd to be the *Integer*, viz. L. 966 : 12 : — as before, Pages 216 and 222.

Or,

Or, 10*s.* — 716
10 — 716
5 — 358
2 — 143 : 2
27 | 2 | 1933 : 2

Here I ſuppoſe the given *Quantity* to be 10 *Shillings*, and take the *Parts*, as above, and the *Total* is 1933 10 *Shillings*, and 2*s.* over, which divided by 2, makes the Whole come to L. 966 : 12, as before.

L. 966 : 12

*EXAMPLE* 9.

1 L. 849 Pieces at 36*s. each.*
4*s.* is $\frac{1}{5}$ 169 : 16
4 — 169 : 16
4 — 169 : 16
4 — 169 : 16

*L.* 1 : 16 *L.* 1528 : 4

Or, 849

4*s.* is $\frac{1}{5}$ L. 169 : 16
9 Times 4*s.* 9

is 36 *Shillings* or L. 1528 : 4

Anſwer, L. 1528 : 4, as in Pages 216 and 223.

By the firſt *Method*, I ſuppoſe the 849 to be *Pounds*; and then take $\frac{1}{5}$ for 4*s.* and ſet down the *Quotient* 4 *Times*, and *add* all together, whoſe Total is L. 1528 : 4 at L. 1 : 16 or 36 *Shillings*. In the ſecond *Method*, the 849 are alſo ſuppoſed to be *Pounds* Sterling, and after having taken the $\frac{1}{5}$ for 4*s.* I *multiply* that *Quotient* by 9, as taught Pages 45, 46, *&c.* and the *Product* comes to the ſame as before.

*EXAMPLE* 10.

649 Pieces *at* L. 3 : 12 *each.*
649
649
10*s.* is $\frac{1}{2}$ L. 324 : 10
2*s.* is $\frac{1}{5}$ of 10*s.* 64 : 18 : 0

L. 2336 : 8 : - Anſ.

Or, 649
3
1947
4*s.* $\frac{1}{5}$ L. 129 : 16
8*s.* $\frac{2}{5}$ L. 259 : 12
L. 2336 : 8

as in Pages 217 and 223.

Here in the firſt Working, I ſuppoſe the 649 *Pieces* to be *Pounds*, and ſet them down 3 Times for the 3 *Pounds*; then I take the *Parts* for 10*s.* and 2*s.* then *add* all together, and the *Total* is the *Anſwer*. In the ſecond Working I *mul-*

I *multiply* by 3, for the 3 *Pounds*; then I take the Part for 4 *s.* and *multiply* that by 2 for 8 *s.* then *add* all together, and the *Total* is the *Anſwer*, as before.

## *EXAMPLE* 11.

1629 Pieces, *at* 4 *s.* 6 *d. each.*

| | | | | | |
|---|---|---|---|---|---|
| 2 *s.* is $\frac{1}{10}$ | L. | 162 | 18 | - | |
| 2 | 6 is $\frac{4}{8}$ | L. | 203 | 12 | 6 |
| 4 | 6 | L. | 366 | 10 | 6 |

as in Pages 217 and 223.

Or, 1629

| | | | | | |
|---|---|---|---|---|---|
| 4 *s.* is $\frac{1}{4}$ | L. | 325 | 16 | - | |
| 0 | 6. is $\frac{1}{8}$ of 4 *s.* | | 40 | 14 | 6 |
| 4 | 6 — | L. | 366 | 10 | 6 |

In the firſt *Method* of this *Example*, both the *Parts* are taken immediately from the *Pound* Sterling; and conſequently the firſt Line is the Dividend to both the Parts, and is ſuppoſed to be ſo many *Pounds*, which muſt be *divided* firſt by 10, for the Amount of 1629 *Pieces*, at 2 *s.* per *Piece*, and then by 8, for the Amount of the ſame at 2 *s.* 6 *d.* each; then thoſe 2 Lines or Amounts *added* together, is the Value of the Whole at 4 *s.* 6 *d.* a *Piece*. In the ſecond *Method* 4 *s.* is taken as a Part of a Pound, but the 6 *d.* is taken as a Part of 4 *s.* and therefore the *Quotient* of the firſt Work becomes the *Dividend* to the ſecond Work.

## *EXAMPLE* 12.

519 Pieces at 9 *s.* each.

| | | | | |
|---|---|---|---|---|
| 4 *s.* $\frac{4}{5}$ | L. | 103 | 16 | |
| 5 $\frac{1}{4}$ | L. | 129 | 15 | |
| 9 *s.* is | L. | 233 | 11 | Anſ. |

as in Page 217.

Or, 519 Ten-Shillings.

$\frac{1}{10}$ is 51 : 9 to be ſub. for 1 *s.*

467 : 1 Rem. for 9 *s.*

L. 233 : 11 Anſwer.

Here, in the firſt *Method*, I ſuppoſe the Quantity given to be Pounds, and then I break the given Price 9 *s.* into 4 *s.* and 5 *s.* and find the Amount of each; then I add thoſe 2 Lines together, and the Total is the Amount of the Whole. In the ſecond *Method*, I ſuppoſe the whole Number of Pieces to be ſo many 10 Shillings, from which I ſubſtract $\frac{1}{10}$ of it ſelf, and there remains 467 Ten-Shillings,

lings, and 1 Shilling: I divide 467 by 2, becauſe 2 Ten-Shillings is 1 Pound; and the Anſwer is the ſame as before.

## *EXAMPLE* 13.

| | *Quarters.* | | | *Quarters.* |
|---|---|---|---|---|
| | L. — 365 at L. 1 : 3 : 6 | | | |
| 2 : 6 is $\frac{1}{8}$ | L. — 45 : 12 : 6 | At 1 | L. 365 is | L. 365 : |
| 1 — $\frac{1}{20}$ | L. — 18 : 5 : | at 2*s.* | $\frac{1}{10}$ | L. 036 : 10 |
| | | at 1*s.* or $\frac{1}{2}$ of 2*s.* | | 18 : 5 |
| | L. 428 : 17 : 6 | at 6*d.* or $\frac{1}{2}$ of 1*s.* | | 09 : 02 : 6 |

Anſwer, 365 Quarters at L. 1 : 3 : 6 is L. 428 : 17 : 6 as before, Pages 217 and 223.

In this *Example*, as the *Price* is 1 *Pound* and *odd Money*, I ſuppoſe the Quarters to be changed into *Pounds*, for the one *Pound*; and then take the Parts for the *odd Money*, and add what they amount to, to the *Pounds*, and the Total is the Anſwer, as appears by the different Ways by which they are done, here, and Pages 217 and 224.

## *EXAMPLE* 14.

95 Oxen, at L. 8 : 7 : 11 each.

| | | | | |
|---|---|---|---|---|
| | | | | 8 |
| Value of 8 | Oxen, | 67 | : 3 : | 4 |
| | | | | 12 |
| Value of 96 | Oxen, | 806 | : - : | - |
| 1 | ſubſtracted | 8 | : 7 : | 11 |
| 95 | remains, | L. 797 | : 12 : | 1 |

Here I firſt *multiply* the given *Price* by 8, and that *Product* by 12; and the laſt Product is the Amount of 96; from which ſubſtract 1, and the Remainder is L. 797 : 12 : 1 for 95, the ſame as in Pages 218 and 224.

On

Or, 95 at L. 8 : 7 : 11
8

760 Value at L. 8 each.
4 *s.* is $\frac{1}{4}$ of a L. 19 Value at 4 *s.* each.
4 *s.* is $\frac{1}{4}$ of a L. 19 Ditto.

L. 798 Value at L. 1 : 8.
95 at 1 *d.* each is 0 : 07 : 11 to be ſubſtracted.

95 at L. 8 : 7 : 11 is 797 : 12 : 1 the true Value.

Here I multiply by 8, and take twice 4 *s.* which is one Penny two much; therefore I ſubſtract 95 Pence, or 7 *s.* 11 *d.* from the Whole, and then the Anſwer is the ſame as before.

By comparing theſe 14 *Examples*, wrought by the two general Methods, and by theſe particular Methods, you may perceive that ſometimes the *Decimal* Way, and ſometimes the others are the ſhorteſt: Only you muſt obſerve that in the *Decimal* Way, you uſe only Multiplication, and have the Anſwer always in Pounds and Parts, whoſe Value is immediately known; and if you uſe the Contraction, 'twill generally give the Anſwer in the feweſt Figures.

As *Iron*, *Copper*, *Tobacco*, *Sugar*, *Lead*, &c. are the common *Commodities* weighed by *Avoirdupoiſe Weight*; I will now ſhew you a particular *Method* of working *Queſtions* of that Kind.

## *RULE.*

*In all Goods ſold by the* Ton Weight (*let the real Price be what it will*) *ſuppoſe them at one* Pound *per* Ton, *and then the given Quantity of* Tons *will be ſo many* Pounds; *and if there be any odd* Hundreds, *they will be ſo many* Shillings; *the* Quarters *will be ſo many Three-pences*; *and for the* Pounds Weight, *you may reckon either ſo many* $\frac{1}{28}$ *of a* Penny, *or ſo many* $\frac{1}{7}$ *of a* Farthing, *as you pleaſe* (*both being of the ſame Value*;) *this done*, multiply *the Whole by the* Pounds *in* Money *one* Ton *coſt*, *and take the Parts for the* odd Money; *add theſe* Quotients *to the given* Product, *and the* Total *will be the* Value *or* Amount *of the* Whole.

## *EXAMPLES.*

*T. C. Q. lb.*

*What comes* 56 : 17 : 3 : 15 *of Iron to, at L.* 15. 15 *s. per* Ton?
*Anſ. L.* 896 : 1 : 8 and $\frac{1}{4}$ of a *Farthing.*

| *L.* | *s.* | *d.* | | |
|---|---|---|---|---|
| 56 : | 17 : | 10 | $\frac{1}{2}$ $\frac{1}{7}$ | |
| | | | 5 | |
| 284 : | 9 : | 5 | - 1 | Value at L. 5 per *Ton.* |
| | | | 3 | |
| 853 : | 8 : | 3 | 3 | Value at L. 15 per *Ton.* |
| 10 *s.* is $\frac{1}{2}$ L. 28 : | 8 : | 11 | $\frac{1}{4}$ 1 + $\frac{1}{2}$. | |
| 5 *s.* is $\frac{1}{2}$ 10 *s.* 14 : | 4 : | 5 | $\frac{1}{2}$ 4 + 0 + $\frac{1}{2}$. | |
| 896 : | 1 : | 8 | 1 + $\frac{1}{2}$ + $\frac{1}{2}$ = $\frac{2}{28}$ | or $\frac{1}{4}$ of a *Far.* |

Here I ſuppoſe the *Price* to be one *Pound* per *Ton*, and ſo I ſet down 56 *Pounds* for 56 *Tons*, 17 *Shillings* for 17 *Cs*, 9 *Pence* for 3 *Quarters*, and 1 *d.* $\frac{1}{2}$, and $\frac{1}{7}$ of a *Farthing* for the 15 *Pounds*; 15 *Times* $\frac{1}{7}$ of a *Farthing* coming to ſix *Farthings*; and $\frac{1}{7}$ over, which *added* to the 9 *Pence*, make 10 *Pence Half-penny*, and $\frac{1}{7}$ of a *Farthing*: Then as the given *Price* is 15 whole *Pounds*, I *multiply* firſt by 3, and then by 5, and the laſt *Product* is the whole Amount at *L.* 15 per *Ton*: Then I take the $\frac{1}{2}$ of the firſt Line, which is the *Value* of 1 *Pound* per *Ton*, for *Ten Shillings*, and that is the Amount at 10 *s.* per *Ton*, and then the $\frac{1}{2}$ of that is the *Value* at 15 *s.* per *Ton*; theſe laſt 3 Lines *added* together is the Amount at *L.* 15 : 15 per *Ton*: And that I may be certain of the Truth of the Work, I ſet down the *Amount* at 1 *L.* again; only now I reckon the odd *Pounds* at $\frac{1}{28}$ of a Penny per *Pound*: So that the whole Amount at 1 L. is now L. 56 : 17 : 10 $\frac{14}{17}$.

L. 56

L. 56 : 17 : 10 $\frac{24}{28}$ *
4

and 227 : 11 : 6 - 12 is the *Value* at 4L. *p. Ton*
4

and 910 : 6 : 1 - 20 *ditto* at 16 L. *per Ton.*
Deduct 14 : 4 : 5 - 18 + $\frac{1}{4}$ *Value* at 5*s. p. Ton.*

The Remainder 896 : 1 : 8 - 1 + $\frac{1}{4}$ *Value* at L. 15 : 15.

*per Ton*; which is exactly the same with the former, for when the remaining *Fraction* is valued 'twill come to $\frac{7}{112}$ of a Penny, or $\frac{1}{4}$ of a *Farthing*, according to the Directions given, Page 154.

You see the above *Quantity* in this last Method is wrought at L. 16 per *Ton*; and therefore the Amount at 5*s.* per *Ton* is substracted to reduce it to L. 15 : 15 per *Ton.*

* *N. B.* The 28, or *Denominator* of the *Fraction* is here set at Top to save the repeating it so often as the Work would otherwise require; and so only the *Numerators* are set down in the Work. Now you shall see the same *Example* wrought by *Decimals.*

*T. C. Q. lb.*
*At* L. 15 : 15 per *Ton*, *What comes* 56 : 17 : 3 : 15 *to?*

*Tons. Decimal Parts.*
56,8941914
5751 Price of 1 *Ton* inverted.

56 8942
28 4471
3 9826
2845

L. 896,084

The *Decimal* to 17 *C.* 3 *Qr.* 15 *lb.* when a *Ton* is the *Integer*, comes to ,8941914, and the *Price* is L. 15,75; but as 3 *Decimal* Places are sufficient to be in the *Product* for the *Answer*, I do the Work contractedly, and it comes

to

to 896 *whole Numbers*, or *Pounds* Sterling, and ,084 Parts; which by the Rule, *Page* 203, comes to 1 *s.* 8 *d. Farthing*; but by the Rule, Page 170, 'twould be but 1 *s.* 8 *d.* and ſome Parts of a *Farthing*, the ſame with the firſt two *Methods*.

*T. C. Q. lb.*

*What comes* 61 : 13 : 1 : 7 *of Copper to at* L. 87 : 13 : 6 per *Ton?* Anſ. *L.* 5406 : 10 : 8.

Whole Q. at 1 L. per *Ton* is L. 61 : 13 : $3\frac{4}{8}$

At L. 3 per *Ton* is L. 493 : 6 : 6
11

At 88 L. per *Ton* is L. 5426 : 11 : 6
Subſtract L. 1 per *Ton* and

| | | | |
|---|---|---|---|
| 87 *L.* per *Ton* is | L. 5364 | : 18 : | 2 - 1 |
| 10 *s.* per *Ton* is — | 30 | : 16 : | 7 - 3 + $\frac{4}{1}$ |
| 2 : 6 *d.* per *Ton* is — | 7 | : 14 : | 1 - 3 + 1 + $\frac{4}{3}$ |
| 1 *s.* per *Ton* is — | 3 | : 1 : | 7 - 3 + 1 + 3 + $\frac{10}{9}$ |
| At L. 87 : 13 : 6 *p. T. Tot.* is | L. 5406 | : 10 : | 8 and $\frac{12}{40}$ of a *Far.* |

*Decimally* the Work will ſtand thus:

| | *T. Dec. Parts.* | *T. C. Q. lb.* |
|---|---|---|
| Quantity | 61,665625 | for 61 : 13 : 1 : 7 |
| Pr. p. *T.* invert. | 57678 | for L. 87 : 13 : 6 - |

4933250
431659
36999
4317
308

5406,533, or L. 5406 : 10 : 8.

Wherever the *Quantity* is whole *Numbers*, you may break the ſaid *Quantity* into any of the component Parts, and work as formerly taught you, Pages 51, 52, *&c.* or you may work by any of the latter *Methods*, as beſt pleaſes you;

but in general the *Decimal* Way will be both the plaineſt and eaſieſt.

*Bought* 816 *Pieces of* Dowlaſs *at L.* 1 : 6 : 6 per *Piece, What come they to?*

This *Example* is wrought by the *Rules* in Pages 51, 52, *&c.*

L. 1 : 6 : 6 the Value of 1 Piece.
9
11 : 18 : 6 the Value of 9 Pieces.
9
107 : 6 : 6 the Value of 81 Pieces.
10
1073 : 5 : — Value of 810 Pieces.
7 : 19 : — the Val. of 6 Pieces.
L. 1081 : 4 : — the Value of 816 Pieces.

The ſame *Decimally* L. 1,325 is the Value of 1 Piece.
816 Number of Pieces.
7950
1325
10600
L. 1081,200 the Value of 816 Pieces,
which is L. 1081 : 4

Or thus:
At 1 L. 816 at L. 1 : 6 : 6
5*s.* is ¼ L. 204 —
1*s.* ⅕ of 5*s.* 40 - 16
6*d.* ½ of 1*s.* 20 - 8
Total L. 1081 - 4

Or you may do thus:
816 Pieces.
53 Sixpences 1 coſt.
2448
4080
410 | 43248 Sixpences all coſt.
L. 1081 - 4

If you was to compute *Ingots* of *Standard Silver*, you might do it thus:

*What*

*What comes* 8 *Ingots of Standard Silver to, Quantity* lb. *Oz. Dwts. s. d.*
315 : 7 : 10 *at* 5 : 2 per *Ounce?*

| | | | | |
|---|---|---|---|---|
| | | | lb. | Oz. |
| L. 315 : | 11 : | 8 | for 315 : | 7 at 1 *L.* per lb. |
| | | 10 | for — | 10 Dwts. at ditto. |
| L. 315 : | 12 : | 6 | for 315 : | 7 : 10 at 1 *L.* per lb. Weight. |
| | | 3 | | |
| L. 946 : | 17 : | 6 | for ditto at 3 L. per lb. Weight. | |
| 31 : | 11 : | 3 | for ditto at 2 *s.* per lb. Weight. | |
| L. 978 : | 8 : | 9 | for ditto at L. 3 : 2 per lb. Weight. | |

## *EXPLANATION.*

At 1 *L.* per lb. Weight, 'tis plain the *Money* and the lb's Weight will be the ſame; and for every *Ounce* you muſt reckon 1 *s.* 8 *d.* or 20 Pence; which for 7 *Ounces*, comes to 11 *s.* 8 *d.* and for every *Penny Weight* you muſt reckon one *Penny* in *Money*; becauſe as one Ounce comes to 20 *Pence*, a *Penny Weight* muſt come to one *Penny*; therefore for ſo many *Penny Weights*, as you have, you muſt ſet down ſo many *Pence*, as in this *Example*, 10 *Pence*; ſo that the whole *Quantity* at 1 *Pound* or twenty *Shillings* per *Pound Weight*, comes to L. 315 : 12 : 6; which *multiply'd* by 3 for the 3 *Pounds*, gives L. 946 : 17 : 6; and 2 *s.* being $\frac{1}{10}$ of a *Pound* Sterling $\frac{1}{10}$ of L. 315 : 12 : 6, which is 31 : 11 : 3, being added to the L. 946 : 17 : 6 makes L. 978 : 8 : 9 for the *Total* Amount, as may be try'd by working the ſame Queſtion *Decimally* thus:

,5833 *Decimal* to 7 *Oz.*
,0416 *ditto* to 10 *Dwts.*

lb. Parts.
315, 625
3,1 Price.

315, 625
9468 75

L. 978, 4375, or L. 978 : 8 : 9, as before.

Here

Here taking the *Decimals* for the *Oz.* and *Dwts.* out of the *Table*, Page 206, which being *added* according to the Rule of *ſingle Repetends*, produces a perfect *Decimal*, viz. 625, which *added* to the whole *Number* or *Pounds*, makes 315,625; this *multiply'd* by 3. 1, *viz.* L.3 for the *Pounds*, and 1 for 2 *Shillings*, produces as above L.978 *Pounds*, and 4375 *Parts*; which by the Rule, Page 203, comes to 8 *s.* and 9 *d.* as by the foregoing Method.

After the ſame Manner you may go on in any other Weight and Meaſure, regarding only the ſeveral Subdiviſions: As for Example,

*What comes* 5 *Hogſheads of* Sugar *to*, *Quantity* 47 : 1 : 12 *at* L. 2 : 17 : 9 per *C?*

| | | *C.* | *Q.* | *lb.* |
|---|---|---|---|---|
| L. 47 : 5 : — | for | 47 | 1 | — |
| 2 : 1 ¾ | for | — | — | 12 |
| Whole at 1 L. *C.* is 47 : 7 : 1 : 5 | for | 47 | 1 | 12 at 1 *L.* : 3 |
| Dit. at 3 *L.* per *C.* 142 : 1 : 5 : 1 | at | L. 3 | per | *C.* |
| Dit. at 2 *s.* per *C.* 4 : 14 : 8 : 4 | | | | |
| Dit. at 3 *d.* per *C.* — : 11 : 10 : + ½ | | | | |
| *Tot.* to be ſubſtract. 5 : 6 : 6 : 4 + ½ | | | | |
| Rem. is Whole at L. 2 : 17 : 9 *p. C.* 136 : 14 : 10 : 3 + ½ | | | | |

Or thus:

| | | | | | |
|---|---|---|---|---|---|
| The Whole at 1 L. is L. | 47 | 7 | 1 | ⅕ | |
| Ditto 1 — | 47 | 7 | 1 | 5 | |
| Ditto 0 : 10 *s.* | 23 | 13 | 6 | 6 | |
| Ditto 0 : 5 *s.* | 11 | 16 | 9 | 3 | |
| Ditto 0 : 2 6 *d.* | 5 | 18 | 4 | 5 | |
| Ditto 0 : - 3 | — | 11 | 10 | - ½ | |
| At L. 2 : 17 : 9 Whole is L. | 136 | 14 | 10 | 3 + ½ | |

Or thus:

| | *C. Parts.* | |
|---|---|---|
| ,25 is the *Dec.* to ¼ *C.* | 47,35714, *&c.* | |
| ,10714 and dit. to 12 *lb.* | 57 882 | Price inverted. |
| ,35714 dit. to 1 *Q.* 12 *lb.* | 94 714 | |
| to which *add* the 47 *C.* or | 37 886 | |
| whole *Numbers*, and it is | 3 789 | |
| 47,35714, *&c.* | 331 | |
| | 24 | |

*Total* Amount is L. 136,744 or L.136:14:10½.

## *OBSERVATIONS.*

Above, in the firſt *Method*, 47 *C.* at 1 L. per *C.* is *L.*47, and conſequently 1 *Quarter* muſt be 5 *Shillings*; then 12 lb. being ⅐ of a *Quarter* of a hundred *Weight*, ⅐ of 5 *s.* is 2 *s.* 1 *d.* and ⅐; but for convenience, I generally put the *Denominator* of the *Fraction* uppermoſt; and then the Whole at 1 *L.* per *C.* ſtands thus: *L.*47 : 7 : 1 ⅐, and the given *Price* being near 3 *L.* per *C.* I *multiply* by 3, and have *L.*142 : 1 : 5 ⅐, from which I *ſubſtract* the Amount of the whole *Quantity* at 2 *s.* 3 *d.* per *C.* which is the Difference between L. 3 and L.2 : 17 : 9, the given Price, which being L.5: 6 : 6 ¾ + ½, the *Remainder* is L.136 : 14 : 10 ⅓ + ½, or L.136 : 14: 10½; for ⅓ + ½ of a *Penny* is juſt a *Halfpenny*; and that I may be ſatisfied of the Truth of this Work, I ſet down firſt the *Amount* at 1 L.per C. twice; then the *Amount* at 10 *Shillings*; at 5 *Shillings*; at 2 *s.* 6 *d.* and at 3 *d.* and *adding* theſe all together, I have the *Amount* at L. 2 : 17 : 9, which comes to the ſame as before: And for a further *Trial*, I do it *Decimally*; and by the *Table*, Page 208, find the whole Weight comes to 47,35714, *&c.* as above; for as three *Decimal* Places are ſufficient for the Anſwer, I don't take down all the *Figures* in the *Table*; then the Price will be found per the *Table*, Page 205, to be *L.*2,8875, which is inverted, and wrought as formerly directed, in *Multiplication* of *Decimals*, and the *Product* comes out *L.* 136 . 744, or *L.*136 : 14 : 10 ½, the ſame with the two foregoing *Methods*, by which it plainly appears all is done right: So that you may uſe which *Method* you like beſt; but the *Decimal*

*Way* is the eaſieſt. The common, and indeed general Method of doing ſuch like Queſtions, is as follows.

| | C. | Q. | lb. | | | |
|---|---|---|---|---|---|---|
| 1 L. - - | 47 | 1 | 12 | at L. 2 : 17 : 9 | per C. | |
| 1 L. - - | 47 | — | — | | | |
| 10 s. $\frac{1}{2}$ L. | 23 | 10 | — | 14 : $5\frac{1}{4}$ | is 1 | Q. |
| 5 $\frac{1}{2}$ 10 s. | 11 | 15 | — | 2 : $-\frac{1}{4}$ | is 4 | lb. |
| 2 : $6\frac{1}{2}$ 5 s. | 5 | 17 | 6 | 4 : $1\frac{1}{2}$ | is 8 | lb. |
| $3\frac{1}{10}$ : 2 : 6 - | 11 | 15 | 9 | | | |
| | | | | L. 1 : 00 : $7\frac{1}{2}$ | | |

| | | C. | Q. | lb. |
|---|---|---|---|---|
| 2 L. 17 s 9 d. | L. 135 : 14 : 3 | for 47 | — | — |
| | 1 : — : $7\frac{1}{2}$ | for — | 1 | 12 |
| | L. 136 : 14 : $10\frac{1}{2}$ | for 47 | 1 | 12 |

In this laſt *Method* the 47 *C.* is wrought alone, and the Parts are alſo done by themſelves and added to the Amount of the 47 *C.*

I have now ſo fully explain'd this *Rule*, that I think there can remain no *Difficulty*, but what ſome or other of the foregoing *Methods* will eaſily maſter; and indeed I would recommend the *Decimal Way* to be uſed univerſally, both for its Eaſe and Certainty, not being incumber'd with variety of Denominations; for after the Parts of any Quantity whatever are found, either by the *Table*, or otherwiſe, then the Proceſs is the ſame with plain ſimple *Multiplication*, tho' the *Product* is applicable to any *Species* of *Coin*, *Weight*, *Meaſure*, &c. Before I quit this Subject, I will apply it to what is commonly made a diſtinct Rule, call'd,

## *TARE* and *TRET*, &c.

To know the neareſt and beſt *Methods* of working all *Queſtions* of this Kind, is abſolutely neceſſary for all *Merchants* and great *Traders*; and in my Opinion, 'tis beſt done by the *Rule* of *Practice*, in which I will ſhew you ſeveral Ways of performing it, that you may chuſe for yourſelf that which you think *beſt*, moſt *eaſy*, and *expeditious:* But before we treat of the Methods of Working, 'twill be proper to explain the Thing; to expreſs which, there are ſeve-

ral *Technical Terms* or *Words* of *Art* us'd; ſuch as *Groſs*, *Tare*, *Tret*, *Clough* or *Cloff*, &c. the Meaning whereof is, that all Goods that are liable to an eaſy Separation, and conſequently a Loſs or Detriment, and are ſold by Weight; ſuch as *Tobacco*, *Sugar*, *Rice*, *Tea*, &c. are put into *Casks*, *Bags*, &c. but as 'twould be inconvenient to ſtrip them of theſe Coverings, the ſaid *Casks*, *Bags*, &c. are weigh'd along or together with the *Goods*; and this Weight of both *Cask*, *Bag*, &c. and *Goods*, is called *Groſs-Weight*; but as the ſaid *Wrappers*, *Casks* or *Bags*, are eſteemed of little or no Value, therefore more or leſs *per* C. *Weight*, or *per Cask*, *Bag*, &c. is allowed to be deducted out of the ſaid *Groſs-Weight*, for the Weight of the ſaid *Cask*, *Bag*, &c. and this *Allowance* is called *TARE*; and in ſome Goods there is no further Allowance made, and in others there are, which the particular *Cuſtoms* of particular *Dealers* and *Commodities* muſt determine, both what Quantity, and upon what Sorts ſuch further *Allowance* is made, which is called *TRET*, and is uſually 4 lb. in 104 lb. or $\frac{1}{26}$ Part of the Nett Commodity, after the *Allowance* for the *Cask*, *Bag*, &c. has been deducted, which is ſuppoſed to be ſpoil'd, or at leaſt much injur'd by the rolling of the Casks, Cheſts, Bags, *&c.* at Sea, *&c.* as in Tea, where by ſuch Motion, ſo much, or more is ſuppoſed to be broken to Duſt or Powder, *&c.*

*CLOFF* is yet a further Allowance after the other two are deducted, made in ſome *Commodities*, by the Great or Wholeſale *Dealers* to the *Retailers*, to enable them to make many *Draughts* or ſmall *Parcels* out of one large one; and this is 2 lb. upon every 3 C. *Weight*; when all, or ſo many of theſe *Allowances*, as are cuſtomary, are made, the *Remainder* is called *Nett Weight*, and is what the Buyer muſt pay for at the Price agreed upon.

## *EXAMPLES.*

*What is the Nett Weight of* 8 *Casks of Indigo, Quantity Groſs* 37 *C.* 3 *Q.* 15 *lb. if* 30 *lb. be allowed for Tare to each* Caſk?

| | Q. | lb. | |
|---|---|---|---|
| 30 lb. is | 1 | : 2 | Tare of one Caſk. |
| | | 8 | Number of Caſks. |
| 2 | : - | : 16 | the whole Quant. of *Tare* to be deduct. |

| C. | Q. | lb. | |
|---|---|---|---|
| 37 | 3 | 15 | Groſs Weight. |
| 2 | - | 16 | Tare. |
| 35 | 2 | 27 | Nett Weight. |

*What is the Nett Weight of* 16 *Casks of* Argol, *Quantity, Groſs,* 123 *C.* 2 *Q.* 17 *lb. Tare at* 14 *lb. per* C. *Weight?*

14 lb. is $\frac{1}{8}$ C.

| | | | |
|---|---|---|---|
| 123 | 2 | 17 | Groſs. |
| 15 | 1 | 23 $\frac{1}{8}$ | Tare. |
| 108 | - | 22 | Nett. |

Here as 14 lb. is an exact *Aliquot Part* of a C. *viz.* the $\frac{1}{8}$, I *divide* by 8, ſaying, the 8's in 12 is 1, and 4 over; in 43 is 5, and 3 over, which being 3 C. is 12 *Quarters*; which with the 2 *Quarters* in the given *Quantity* is 14; the 8*s.* in 14 is 1, and 6 over, which is 168 *Pounds*, to which the 17 being *added*, makes 185, the 8's in which are 23 and 1 over; but in all theſe *Groſs Goods*, ſo ſmall a Matter as $\frac{1}{8}$ of a *Pound* or 2 *Ounces* is rejected; but if it had come to $\frac{2}{8}$ 'twould have been eſteemed as a *Pound*, no Parts leſs than a *Pound* in this Work being taken Notice of; tho' for Exactneſs and Curioſity ſake, you may do as you pleaſe in Calculation, tho' not in Buſineſs; for there the cuſtomary Methods muſt be followed.

*Suppoſe I have the following Invoyce or Bill of Parcels of* 5 *Hogſheads of Tobacco, upon which I am to be allowed* Tret *after the* Tare *is deducted, How much is the Nett Weight?* Anſ.

| | | | C. | Q. | lb. | | lb. |
|---|---|---|---|---|---|---|---|
| N° 1 | *Quantity* | *Groſs* | 6 | 1 | 17 | *Tare* | 99 |
| 7 | - | - | 5 | 3 | 18 | | 82 |
| 9 | - | - | 5 | 1 | 9 | | 76 |
| 6 | - | - | 8 | - | 7 | | 104 |
| 15 | - | - | 7 | 2 | 14 | | 98 |
| 5 Casks | | Groſs | 33 | 1 | 9 | Tare | 459 |

5 *Casks*

5 *Casks, Groſs* 33 : 1 : 9 *Tare* 459.

33
33.
33..
..37 the lb's in 1 Q. and 9 lb.

3733 *Groſs Pounds.*
459 *Tare.*

26) 3274 *Suttle Pounds.*
126 *Tret.*

| | | C. | Q. | lb. |
|---|---|---|---|---|
| Pounds | 3148 *Nett*, or | 28 | - | 12 |

Here, after *adding* the *Quantities* together, the *Groſs Weight* is 33 C. 1 Q. 9 lb. which is brought into *Pounds*, by ſetting down the 33 firſt under itſelf, then 1 Place more to the Left-hand, and then 2 Places; and for the 1 Quarter and 9 *Pounds*, which is 37 *Pounds*, 37 is ſet down under the *Units* and *Tens* Places; and the Whole *added* together is 3733 *Pounds Groſs.*

The Reaſon of this Proceſs is, that 112 *Pounds* being C. *Weight*, the 33 *twice* ſet down under one another, is inſtead of *multiplying* by 2; and ſetting the ſame Figures one Place towards the *Left-hand*, is *multiplying* by 10; and ſetting the ſame *Figures* two Places towards the *Left-hand*, is *multiplying* by 100, which collected, is 112; to which add the *Pounds* of the Part, and you have the *Pounds* in the whole *Quantity.* Note, *This Method is always uſed at the Water-ſide, upon Account of its Eaſineſs, nothing but Addition being required in it.* From which the *Tare* 459 being deducted, when there is a further *Allowance* of *Tret*, the *Remainder* is called *Suttle-Pounds* or *Weight*, which is divided by 26, becauſe 4 *Pounds* is $\frac{1}{26}$ of 104, and the *Quotient* is here made 126, tho' the true *Quotient* is but 125, and $\frac{2}{3}$; which *Fraction* being near an *Integer*, 'tis common to make it a whole *Pound*, the *Seller* giving the *Buyer* this ſmall Advantage, that when the Calculation comes to $\frac{1}{2}$ a *Pound* or upwards, to make it a whole *Pound*; which 126 being *ſubſtracted* from the former *Remainder* or *Suttle-Pounds*, leaves 3148 *Pounds*, or 28 C. - 12 lb. *Nett-Weight* to be paid for.

*Sup-*

*Suppoſe I am allowed only* ½ lb. *Tare for every ſcore Pounds Groſs, What is the Nett-Weight of* 42 : 3 : 12 *Groſs?*

C. Q. lb.
42 : 3 : 12 Groſs.

42
42.
42..
96

4 | 0 | 480,0 Groſs.
0120 Tare.

4680 Nett lb's or 41 C. 3 Q. 4 lb. Nett.

37 *Frails of Raiſins, Quantity each Groſs* 2 C. 3 Q. 12 lb. *Tare* 20 lb. *per Frail, What's the Nett-Weight of the Whole?* Anſ. 99 C. - 12 lb.

| | | | |
|---|---|---|---|
| 1 Frail | 2 : 3 : 12 | | |
| | 6 | | |
| 6 Ditto | 17 : - : 16 | | |
| | 6 | | |
| 36 Dit. | 102 : 3 : 12 | | |
| 1 Ditto | 2 : 3 : 12 | | |
| 37 Dit. | 105 : 2 : 24 | Groſs. | |
| | 6 : 2 : 12 | Tare. | |
| | 99 : - : 12 | Nett. | |

Q. lb.
1 : 9
4

1 : 1 : 8
5

6 : 2 : 12 Tare.

Or thus:
2 : 3 : 12 Groſs.
20 Tare.

2 : 2 : 20 Nett, p. Frail.
6

16 : - : 8 Six Frails.
6

96 : 1 : 20 = 36 Ditto.
2 : 2 : 20 = 1 Ditto.

99 : - : 12 = 37 dit. N.

Here

Here in the firſt Method the *Frails* being 37, I ſet down 1 Q. 9 lb. which is the ſame with 37 *Pounds*, and *multiply* by 20, *viz.* 4 and 5, and the *Product* is the *Tare* in C. Q. lb's; which *ſubſtracted* from the whole Groſs Weight, leaves the Nett Weight. Or you may bring both Parts into *Pounds*, thus:

| | |
|---|---|
| 2 : 3 : 12 | 37 |
| .2 | 20 |
| 2. | 740 |
| 2.. | |
| 96 | |

320 Pounds *Groſs* in a *Frail.*
37 *Frails.*

2240
960

11840 Groſs *Pounds* in all.
740 *Tare* in all.

*C. Q. lb.*
11100 Nett *Pounds* in all, or 99 : - : 12.

Or *Decimally* thus:

2 : 75 for 2 C. ¾.
,10714287 for 12 lb.

2,85714287
,17857134 deduct for 20 lb. Tare.

2,67857153 Nett Weight of 1 *Frail.*
37

18,75000071
80,34714590

99,10714661 Nett Weight of the Whole.

C. Q. lb.
Or, 99 : - : 12, as before.

Note,

Note, *Tho' I have taken down the whole Number of Figures that are in the Table, in the Example above, yet you need not be so very curious, for in such Sort of Examples as these, five Figures would be sufficient, as you see by what follows.*

2,75 for 2 C. $\frac{1}{4}$.
,10714 for 12 lb.

2,85714 for 2 C. $\frac{1}{4}$ and 12 lb.
,17857 deduct for 20 lb. Tare.

2,67857 Nett Weight of 1 Frail.
37 Frails.

18 74999
80 3571

99,10709 Nett Wt. of the Whole.

Here the *Answer* is a Trifle less than the *Tabular Number* for 12 *Pounds*, but much larger than 11 *Pounds*: So that in such rough *Commodities* as these, the Difference is insignificant.

*At* 8 lb. *per* C. *What Nett in*
8 is $\frac{1}{14}$ of C.

| | C. | Q. | lb. |
|---|---|---|---|
| | 516 | 2 | 16 *Gross?* |
| | 36 | 3 | 17 *Tare.* |
| | 479 | 2 | 27 *Nett.* |

Here in *dividing* by 14 there remains $\frac{1}{7}$ lb. which being less than $\frac{1}{2}$ *Pound* is rejected.

Or thus:

lb's. 112 Gross in C.
8 Tare in ditto.

lb's 104 Nett per C.
516 C's in all.

624
104.
520..
52 for 2 Quarters.
15 for 16 *Pounds.*

| | C. | Q. | lb. |
|---|---|---|---|
| 53731 or | 479 | 2 | 27 Nett. |

Here taking $\frac{1}{7}$ of 104 for 16 lb. it comes to but 14 $\frac{6}{7}$, which $\frac{6}{7}$ being more than $\frac{1}{2}$ *Pound*, is made one *Pound*, viz. 15.

*What is the Nett Weight of* 49 *Hogſheads of Tobacco, Quantity Groſs* 197 C. 3 Q. 16 lb. *Tare* 80 lb. *per Hogſhead, Tret* 4 lb. *per* 104, *and* Cloff 2 lb. *per* 3 C?

*Note*, 'Tis not uſual to allow *Tret* and *Cloff* upon *Tobacco*, but a pretty large *Tare* only; but I have here put them all, to ſhew the Manner of Calculation, which is the ſame, let the *Species* of the *Goods* be what they will.

80 lb. is $\frac{1}{7}$ of C. Weight; therefore the Number of *Hogſheads*, multiply'd by 5, and that *Product divided* by 7, gives the C's, &c. that all the *Tare* comes to.

| C. | Q. | lb. | |
|---|---|---|---|
| 197 | 3 | 16 | Groſs. |
| 35 | - | - | Tare. |
| 162 | 3 | 16 | Suttle. |
| 6 | 1 | 2 | Tret. |
| 156 | 2 | 14 | Suttle. |
| — | 3 | 20 | Cloff. |
| 155 | 2 | 22 | Nett. |

Thus *Hogſh.* 49 × 5 = 245 ÷ 7 = C. 35 Ta.

Or thus:

| lb. | Q. | lb. |
|---|---|---|
| 80 is | 2 | 24 |
| | | 7 |
| 5 | - | - |
| | | 7 |
| 35 | 0 | 0 |

26) 162 C. 3 Q. 16 lb. (6 C. 1 Q. 1 lb.

156

6 × 4 = 27

26

1 × 28 = 44

26

18 × 4 = 3 | 156 = 52 52 = 104 Cl.

For finding the *Tare* of the Whole, you may work by either of the two Ways above, and you ſee the Reſult is the ſame, *viz.* 35 C. which being *Subſtracted* from the *Groſs*, I *divide* the *Remainder*, 162 C. 3 Q. 16 lb. by 26, as you ſee above at large; where, after the 162 C. has 6 Times 26, which

which is 156, *ſubſtracted* from it, the *Remainder* is 6, or $\frac{6}{26}$ *Parts* of C. This 6 *multiply'd* by 4, the *Quarters* in a C. gives 24, to which adding 3, the *Quarters* in the Sum, the *Total* is 27; this *divided* by 26, gives 1 Quarter, and 1 *remains*, which is $\frac{1}{26}$ Part of a Quarter; this brought into *Pounds*, and the 16 *Pounds* in the *Sum* added to it, makes 44, which *divided* by 26, gives 1 *Pound* and $\frac{18}{26}$ Parts of a Pound; which being more than $\frac{1}{2}$ a *Pound*, I ſet down 2 Pounds inſtead of 1 Pound and $\frac{18}{26}$ *Parts*, as will always be allowed to be done in actual Buſineſs (tho' not in ſtrict *Arithmetical* Calculation) then *ſubſtracting* the 6 : 1 : 2 for the *Tret*, the Remainder is 156 C. 2 Q. 14 lb. And as the *Cloff* is to be 2 *Pounds* upon every 3 C. Weight, I divide the C's by 3 (rejecting the odd Parts) and the *Quotient* is 52, which ſetting down twice, the *Sum* is 104 *Pounds*, or 3 *Quarters* and 20 *Pounds* for the *Cloff*; which being alſo deducted, the Nett Remainder or Goods to be paid for is 155 C. 1 Q. 22 lb.

There are beſides theſe caſually other Allowances, ſuch as Breakage, Damage, &c. of which take an Example.

*If* 12 *Caſks weigh Groſs* 56 C. 1 Q. 17 lb. *and the Tare is* 16 lb. *per* C. *Breakage* 7 lb. *per Caſk, and over and above all* 1 C. 1 Q. 19 lb. *is allowed for Damage, What Nett Weight muſt be paid for?*

| | C. | Q. | lb. | | lb. | |
|---|---|---|---|---|---|---|
| 7 | 56 | 1 | 17 | Groſs 16 is $\frac{1}{7}$ of 112, or C. | | |
| | 8 | 0 | 6 + $\frac{1}{7}$ | which $\frac{1}{7}$ being leſs than $\frac{1}{2}$ lb. is rejected. | | |
| | 48 | 1 | 11 | *Suttle.* | | |
| | — | 3 | — | *Breakage* at 7 lb. per *Caſk* is $\frac{1}{4}$ C. | | |
| | 47 | 2 | 11 | *Suttle.* | | |
| | 1 | 1 | 19 | *Damage.* | | |
| | 46 | - | 20 | *Nett.* | | |

*The ſame Decimally.*

C. Parts.

7 | 56,40179 Groſs.
8,05739 Tare.

48,34440
—,75 — Breakage.

47,59440
1,41964 Damage.

46,17476 Nett, or 46 : - : 20.

*Note*, The laſt *Decimal* does not, by the Table, come to 20 *Pounds*; but as 'tis nearer 20 than 19, I put down the bigger Number, no leſs than a Pound being taken notice of in any Groſs Goods, where ſuch large Quantities are ſold.

I now ſuppoſe this Matter of Tare and Tret, *&c.* and the whole *Rule of Practice* fully and plainly handled, ſo that any thing may be wrought thereby, properly belonging thereto.

## CHAP. IX.

*In which is contained the Inverſe* RULE *of* THREE, *and the ſeveral other Applications of the* Direct Rule of Three, *commonly called by the Names of* Fellowſhip, Barter, Exchange, Loſs *and* Gain, Allegation, Intereſt Simple *and* Compound, *&c.*

### *The Inverſe* RULE *of* THREE.

THIS is called *Inverſe*, or Inverted, becauſe the Rule for working, given you, Page 121, is inverted or turned (as it were) backwards; for in all Queſtions that come under this Head, after your Queſtion is ſtated, as in common, you multiply the firſt and ſecond Numbers together,

ther, and divide their Product by the third Number, and the Quotient is the fourth Number ſought.

*To know when a Queſtion is in the* Rule *of* Three *Direct, or Inverſe.*

You muſt ſee whether the third *Number* in the *Stating* of the *Queſtion* before you, is *bigger* or *leſſer* than the *firſt* Number.

If it is *bigger*, and requires a leſſer *Number* to anſwer the Conditions of the *Queſtion*, than the ſecond given *Number* now is:

Or if it be *leſs*, and requires a *bigger* Number than the *ſecond* given *Number* now is, then it is to be wrought by this *Inverſe* Method; but if the third *Number* is *bigger* than the *firſt*, and requires a *bigger* Number than the *ſecond*, or is *leſs* than the *firſt*, and requires a leſſer *Number* than the *ſecond* now given; then the *Queſtion* is *Direct*, and muſt be wrought as before taught you, in *Page* 121.

## *EXAMPLES.*

*Suppoſe* 6 *Men could build a Wall in* 20 *Days, In what Time would* 12 *Men do the ſame, at the ſame Rate of Working?*

Here I firſt *ſtate* the *Queſtion*, according to the Directions in *Page* 121, thus:

*If* 6 *Men require* 20 *Days, What Time will* 12 *Men require?*

This done, I ſee the third *Number*, which is 12, is bigger than the *firſt* Number 6; and by conſidering the *Queſtion*, I perceive plainly that the *Time* or *Days*, which is the fourth *Number* ſought, muſt be leſs than the ſecond *Number* given; and therefore I conclude this *Queſtion* is to be wrought by the *Inverſe Rule*, thus:

6 —— 20 —— 12

6

12 | 120

Anſw. 10 Days.

Again, *Suppoſe I could go a certain Journey in* 18 *Days, by travelling* 16 *Hours every Day, How many Days ſhould I*

*want to do the like in, if I travelled but* 12 *Hours every Day at the ſame Rate?* Anſ. 24 Days.

*If* 16 *Hours require* 18 *Days, What will* 12 *Hours require?*

Here I ſee that the third *Number* 12, is leſs than the firſt *Number* 16; but 'tis plain 12 *Hours* travelling daily, muſt require more Days to perform the ſame Journey in, than 16 Hours daily travelling at the ſame Rate; and therefore this *Queſtion* alſo falls under this backward or inverted *Method* of working the *Rule* of *Three*, thus:

16 —— 18 —— 12

16

108

18

12 | 288

24

But if the *Queſtion* run thus: *If* 8 *Yards of Cloth coſt* 32 *Shillings, What will* 50 *Yards amount to?*

Here the Operation muſt be *Direct*, and the ſecond and third *Numbers* muſt be *multiply'd* together, and their *Product* divided by the *firſt*, as directed *Page* 121; for when ſtated, the Queſtion will ſtand thus:

8 —— 32 —— 50

Here the third *Number* is *bigger* than the *firſt*, and alſo requires a *bigger* for the fourth than the ſecond here given; for 'tis plain 50 *Yards* of the ſame *Cloth* muſt be *worth* or *coſt* more than 8 *Yards*.—And ſo if the *Queſtion* was thus:

*If* 50 *Yards of Cloth coſt L.* 10, *What will* 8 *Yards of the ſame come to?*

This *Queſtion* ſtated, will ſtand thus:

*L.*

50 —— 10 —— 8

Here the third *Number* is leſs than the firſt, and the fourth Number muſt be leſs than the ſecond; becauſe 8 *Yards* of the ſame *Commodity* cannot *coſt*, or be *worth* as much as 50, therefore this *Queſtion* muſt be wrought by the *Direct* Method.

Method. And now I preſume I have made this Part of the Matter quite plain. My next Buſineſs ſhall be to teach you how to *abbreviate* or *ſhorten* the Work of ſuch *Queſtions*, as are to be wrought by either of theſe Rules.

We will take the laſt *Queſtion* for an *Example*.

*If* 50 *Yards coſt* L. 10. *What will* 8 *Yards coſt?*

Firſt ſee whether the *Queſtion* be *Direct* or *Inverſe*; if *Direct*, after your *Queſtion* is *ſtated*, and before you have done any *Work*, ſee whether there is any common *Number* that will *divide* the firſt and ſecond *Numbers*, or the firſt and third *Numbers*, without leaving any *Remainder*; if there is, divide thereby, and then work with the *Quotients*, as you would have done before they were ſo *abbreviated*: As above, the firſt and ſecond *Numbers* may be *divided* by 10, and then they will be 5—1—8; for 5 and 1 bear the ſame *Proportion* to one another as 50 and 10 do; then *multiply* the ſecond and third together, and *divide* by the *firſt*, and the *Quotient* will be the Anſwer ſought.

As here, -- 8 Times 1 is 8, and this is to be deem'd *Pounds*; divide this 8 by 5, and the *Quotient* is 1 *Pound*, and $\frac{3}{5}$ or 12 *Shillings*.

The ſame may be done in the *Inverſe Rule*, only you muſt mind, that whatever you *divide* the firſt or ſecond Number by, you muſt alſo divide the third by the ſame. By thus *abbreviating* your given *Numbers*, you will frequently reduce your Work into a ſmall Compaſs, which, without it, would many Times be very operoſe.

## *EXAMPLE.*

*If* 6 *Men, in* 20 *Days, can build a Wall, In what Time will* 12 *Men do the ſame?*

| *Men.* | *Days.* | *Men.* |
|---|---|---|
| If 6 | — 20 — | 12 |
| | 1 | |
| 1 | 2\|20 | 2 |
| | 10 | |

Here the firſt and third *Numbers* may be *divided* by 6, and they they become 1 and 2, with which, working as before, the *Anſwer* is alſo the ſame.

Or

Or you may *divide* the ſecond and third by 4, and then the given *Numbers* will ſtand thus:

6 — 5 — 3
6

3 | 30

10

Or, after you have *divided* the ſecond and third, as before, you may *divide* the firſt and third by 3, and then they will be

2 — 5 — 1
2

10 the Anſwer as before.

## COMPANY or FELLOWSHIP.

The *common Schools*, and moſt *Books* wrote upon this *Subject*, make this a diſtinct *Rule*; and therefore thoſe *Lads* that learn at *School*, and other young Perſons that ſtudy this *Science* by *Book*, think themſelves not ſufficiently ſkill'd to anſwer ſuch *Queſtions* as are reduc'd to this Head, till they have formally gone thro' a Set of ſuch *Queſtions*, and learnt the particular Methods of working the ſame, as are uſually given, altho' they can readily work common Queſtions in the *Rule of Three*, and *Practice*: Therefore to conform to Cuſtom, I will here exhibit ſuch *Queſtions* as I judge will be proper for the Exerciſe of this Part of the *Rule of Three*.

But firſt I muſt take Notice that 'tis uſually divided into two Parts or Rules, *viz.*

FELLOWSHIP *or* COMPANY *without Time*,
And, FELLOWSHIP *or* COMPANY *with Time*.

Tho' 'tis to be obſerv'd that in actual *Trade* and *Buſineſs*, the latter is never us'd; but as poſſible *Caſes* may happen, and it can be no harm to have an *Example* or two of the laſt Sort, I will ſet down ſome of both Sorts.

The

The *Name* or *Title* of these Sort of *Questions* naturally indicate, that more than one Person is suppos'd to be concern'd; therefore I will only hint here, that 'tis by this *Method* the *Shares* in *Ships*, Proportions of *Bankruptcies*, Divisions of *Sums* left by *Will*, and actual *Copartnerships* are or may be adjusted.

*Examples of each follow.*

1. A *and* B *enter into Partnership, and make a Common-Stock of* L. 1000, *of which* A *has* L. 400, *and* B L. 600; *at the Year's End they find their Nett Gain in Trade is* L. 217 : 16 : 6, *What is each Man's Part thereof?*

*Note*, Whenever *Time* is mentioned, whether it be *Days*, *Weeks*, *Months*, or *Years*, and all the *Partners Stocks* are suppos'd to be all the *Time* concern'd, then no Notice is taken of the *Time*; and all such *Questions* are understood to be in that Part of this Rule, called *Fellowship without Time*: As is the *Example* now before us, in which, and in all such like, you must say, *As the Sum or Total of all the Partners Stocks is to the whole Gain or Loss; so is each particular Man's Stock to his Share thereof.* As here,

| L. | | L. | s. | d. | | L. |
|---|---|---|---|---|---|---|
| If 10 \| 00 | - - | 217 | 16 | 6 | - - | 4 \| 00 |
| 5 | | | | 2 | | 2 |
| | | \| 435 | 13 | - | | |

L. 87 : 2 : 7 $\frac{1}{5}$ for *A*'s Part.

| L. | | L. | s. | d. | | L. |
|---|---|---|---|---|---|---|
| If 10 \| 00 | - - | 217 | 16 | 6 | - - | 6 \| 00 |
| 5 | | | | 3 | | 3 |
| | | \| 653 | 9 | 6 | | |

L. 130 : 13 : 10 $\frac{4}{5}$ for *B*'s Part.

Here the first and third *Numbers* are first *divided* by 100, which is done by only cutting off 2 *Cyphers*; then the *Remainders*, 10, 4 and 6 are *divided* by 2, which reduces the 1000 to 5, the 400 to 2, and the 600 to 3; by which 2 and 3, *multiplying* the *middle Number*, or *whole Gain*, and *dividing* the several *Products* by 5, the *Quotients* are the respective *Answers* for

for each *Partner's* Share of the ſaid *Gain:* The Truth of which may be known by *adding* the Parts thus found together, and if their *Sum* make up the whole *Gain* or *Loſs*, you may conclude the particular *Shares* are right: Thus,

| | | | | |
|---|---|---|---|---|
| L. | 87 | : 2 : | 7 $\frac{1}{5}$ | *A*'s Part. |
| L. | 130 | : 13 : | 10 $\frac{4}{5}$ | *B*'s Part. |
| Total is L. | 217 | : 16 : | 6 | which is the whole Gain. |

2. *Five Perſons freight a Ship, with five different Sorts of Goods, and agree to divide the Gain or Loſs of the reſpective Goods, in Proportion to their ſeveral Stocks,* viz.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *A* | L. | 179 : 13 : 6 | which gains | L. | 89 : 13 : 7 | | | |
| *B* | L. | 281 : 19 : 4 | which loſes | L. | 42 : 19 : 4 | | | |
| *C* | L. | 312 : 14 : 8 | which loſes | L. | 198 : 17 : 6 | | | |
| *D* | L. | 419 : 11 : - | which gains | L. | 27 : 12 : 4 | | | |
| *E* | L. | 494 : 7 : - | which gains | L. | 216 : — : - | | | |
| | L. | 1688 : 5 : 6 | Tot. Gain | L. | 333 : 5 : 11 | | | |
| | | | Tot. Loſs | L. | 241 : 16 : 10 | | | |
| | | | Balance Gain'd | | 91 : 09 : 1 | | | |

*What is each Man's Share of the Loſs or Gain, according to this Agreement?*

Here the *Value* of the ſeveral particular *Goods* amounts to L. 1688 : 5 : 6, and the *Balance* between the *Loſs* and *Gain* is L. 91 : 9 : 1 *Gain*; then ſay, *As the whole Stock is to the whole Gain, ſo is each particular Stock to its Share of the Gain*; and as the two firſt *Numbers* are always the ſame, turn the odd *Money* of both into *Decimals*, and *divide* the *ſecond* by the *firſt*, and the *Quotient* reſulting will be a fix'd *Multiplier*, by which every particular *Share* or *Stock* being *multiply'd*, the ſeveral *Products* will be the reſpective Shares of the *Gain*.

The fix'd *Multiplier* thus found, will be ,05417, by which each *Sum* that compoſes the whole *Stock*, being *multiply'd*, the contracted Way, the ſeveral Products will be as follows.

L. 179,675

| L. 179,675 | L. 281,986 | L. 312,733 |
|---|---|---|
| 7145.. | 7145.. | 7145.. |
| 8984 | 14098 | 15637 |
| 719 | 1128 | 1251 |
| 18 | 28 | 31 |
| 12 | 20 | 22 |
| L. 9,733 *A*'s Part. | L. 15,274 *B*'s Part. | L. 16,941 *C*'s Part. |

| L. 419,550 | L. 494,350 |
|---|---|
| 7145 | 7145 |
| 20978 | 24718 |
| 1678 | 1977 |
| 42 | 49 |
| 29 | 35 |
| L. 22,727 *D*'s Part. | L. 26,779 *E*'s Part. |

Proof.

| | | | |
|---|---|---|---|
| *A* | 9,733, | or *L.* | 9 : 14 : 8 |
| *B* | 15,274, | or *L.* | 15 : 5 : 5 $\frac{1}{4}$ |
| *C* | 16,941, | or *L.* | 16 : 18 : 9 $\frac{1}{4}$ |
| *D* | 22,727, | or *L.* | 22 : 14 : 6 $\frac{1}{2}$ |
| *E* | 26,779, | or *L.* | 26 : 15 : 7 |
| L. | 91,454, | or *L.* | 91 : 9 : 1 |

*Decimals* are in nothing more uſeful than in ſuch like *Queſtions* as theſe; for if this *Queſtion* was wrought by the common *Method*, the finding of one Man's *Share* would be more Work than by this *Method:* The finding all the *Shares* is, as appears by one Share here following, found by the common *Method.* Therefore I would always adviſe you, when there are ſeveral *Parts* or *Shares* to be found, firſt to find a common or fix'd *Multiplier*; and do with it as you ſee done in this laſt *Example.*

If L. 1688 : 5 : 6 — L. 91 : 9 : 1 — L. 281 : 19 : 4

| | | |
|---|---|---|
| 20 | 20 | 20 |
| 33765 | 1829 | 5639 |
| 12 | 12 | 12 |
| 405186 | 21949 | 67672 |
| | | 21949 |
| | | 609048 |
| | | 270688 |
| | | 609048 |
| | | 67672 |
| | | 135344 |

(12)

405186) 1485332728 (3665 *Pence.*
1215558...

2|0|30|5-5*d.*¼

2697747
2431116 — 15 - 5 *s.*

2666312
2431116

2351968
2025930

326038 Prts of *Pen.*
4

1307752
1215558

92194 Prts of a *Far.*

Here after all the Work is done, the *Anſ.* is *L.* 15 : 5 : 5 ¼, for *B*'s *Share* of the *Gain*, in Proportion to his *Stock* of *L.* 281 : 19 : 4 which is exactly the ſame with the ſecond Operation in the *Decimals*. The like may be ſeen by trying any of the other Parts or Shares.

3. *Suppoſe a Bankrupt's Effects, after all Charges are deducted, ſhould amount to* L. 1739 : 13 : 8 ½, *and his ſeveral Creditors were as follows*, viz.

| | | | | |
|---|---|---|---|---|
| *F* | L. 313 | : 7 | : 3 | |
| *G* | — 290 | : 4 | : 6 | |
| *H* | — 700 | : — | : — | |
| *J* | — 486 | : 13 | : 8 | |
| *K* | — 600 | : — | : — | |
| *L* | — 500 | : — | : — | |
| *M* | — 381 | : 10 | : — | |
| *N* | — 418 | : — | : — | |
| Total Debt | *L.* 3689 | : 15 | : 5 | |

*What must each Man have; and how much did he pay in the Pound?* Answer,

| | | | | | |
|---|---|---|---|---|---|
| *F* | must have L. 147,747 | or L. 147 | : 14 | : 11 $\frac{1}{4}$ |
| *G* | - - - 136,838 | - - 136 | : 16 | : 9 $\frac{1}{4}$ |
| *H* | - - - 330,042 | - - 330 | : — | : 10 |
| *J* | - - - 229,466 | - - 229 | : 9 | : 3 $\frac{3}{4}$ |
| *K* | - - - 282,893 | - - 282 | : 17 | : 10 $\frac{1}{4}$ |
| *L* | - - - 235,744 | - - 235 | : 14 | : 10 $\frac{1}{2}$ |
| *M* | - - - 179,873 | - - 179 | : 17 | : 5 $\frac{1}{2}$ |
| *N* | - - - 197,083 | - - 197 | : 01 | : 8 |
| Total | L. 1739,686 | or L. 1739 | : 13 | : 8 $\frac{1}{2}$ |

*Note*, That as the *Decimal* Places are carried but to three *Figures*, they will not always be quite perfect, but may be a Part of a *Farthing* too much or too little; but you see that in the whole *Total* or *Sum* of all the eight Parts, there's but one *Farthing* too much by the *Decimal* Part, and 0 in the other Part, which is exact enough for all Business.

Here, according to the *Directions*, Page 192, I find a common *Multiplier*, which is used instead of a common *Divisor*; which *Multiplier* also answers that Part of the *Question*, How much per *Pound* does the Bankrupt pay? *viz.* 9 *s.* 5 *d.* and almost $\frac{3}{5}$ of a *Farthing*: For stating the *Question*, I say, *As the whole Debt* L. 3689 : 15 : 5, *or* L. 3689,77083, *is to the whole Credit or Value of the Bankrupt's Estate*, L. 1739 : 13 : 8 $\frac{1}{2}$, or L. 1739,68541$\frac{1}{2}$; so is 1 *Pound to its Part or Share*, or what he pays in the Pound, *viz.* 4714, *&c.* or 9 *s.* 5 *d.* *&c.*

*Viz.*

L. 3689,77083 —— L. 1739,685416 — L. 1

368,97708 —— 173968541

Anſw.

New Div. | 3320,79375 | N. Div. | 1565,716875 (,47148874

1328 317500

237399375

232455563

4943812

3320794

1623018

1328317

294701

265663

29038

26566

2462

2325

137

133

4

Or, L. 0 : 9 : 5 and ,6554 of a *Farthing*, which is almoſt $\frac{2}{3}$.

Here, as the *Decimal* of the *Diviſor* has a ſingle *Repetend*, I work according to the *Directions*, in Pages 194 and 199, and the *Quotient* ,47148874 is both the common *Multiplier*, and the Anſwer to that Part of the *Queſtion*, *How much does he pay in the Pound?* Viz. L. 0 : 9 : 5 and about $\frac{2}{3}$ of a *Farthing*.

And to ſhew the Agreement of all the ſeveral Methods heretofore taught you, I will alſo find the common *Multiplier* without ſubſtracting the *terminate* Figures, and only contract the Work as taught, Page 194, as you ſee here following, and the *Quotient* is the ſame as above.

3689,77083

3689,77083 | 1739,685416 (,47148874
1475908333 20
263777083 | 9|42977480
258283958 | 12
5493125 5|13729760
3689771 4
1803354 53919040
1475918
327436
295182
32254
29518
2736
2583
153
148
5

Or 9 *s.* 5 *d.* and near $\frac{1}{5}$ of a *Farthing*; as will appear by working this Stating by the common Method, as is done below.

| *L.* | *s.* | *d.* | | *L.* | *s.* | *d.* | | L. |
|---|---|---|---|---|---|---|---|---|
| If 3689 | : 15 | : 5 | | 1739 | : 13 | : 8 $\frac{1}{2}$ | | L. 1 |
| 20 | | | | 20 | | | | 20 |
| 73795 | | | | 34793 | | | | 20 |
| 12 | | | | 12 | | | | 12 |
| 885545 | | | | 417524 | | | | 240 |
| | | | | 4 | | | | |
| | | | | 1670098 | | | | |
| | | | | 240 | | | | |
| | | | | 66803920 | | | | |
| | | | | 3340196.. | | | | |

885545) 400823520 (452 *Farthings*.
885545

885545) 400823520 (452 *Farthings.*
3542180..
113 *Pence.*
4660552
4427725 9 : 5
2328270
1771090
557180
885545 Remains, which is almoſt $\frac{1}{5}$ of a *Farthing.*

Here the ſame Anſwer is alſo found by the common or vulgar Method; and now, as in the former Queſtion, I multiply the common Multiplier by each Man's particular Stock, and you'll have the ſeveral Anſwers as below.

,47148874
5263,313
141447
4715
1415
141
28
1

*F*'s Part L. 147,747, Or L. 147 : 14 : 11 $\frac{1}{4}$.

,47148874
522,092
94298
42434
94
9
2

*G*'s Part L. 136,838, Or L. 136 : 16 : 9 $\frac{1}{2}$.

,47148874

,47148874
007

*H*'s Part L. 330,042, or L. 330 : — : 10

,47148874
386,684

188596
37719
2829
283
38
1

*J*'s Part L. 229,466, or L. 229 : 9 : 3¼.

,47148874
006

*K*'s Part L. 282,893, or L. 282 : 17 : 10¼

,47148874
005

*L*'s Part L. 235,744, or L. 235 : 14 : 10½.

,47148874
5,183

141447
37719
471
236

*M*'s Part L. 179,873, or L. 179 : 17 : 5½.

,47148874
814

188596
4715
3772

*N*'s Part *L.* 197,083, or L. 197 : 1 : 8.

'Tis needleſs to obſerve what abundance of *Labour* is ſaved by this *Method* of working, eſpecially where the *Sums* are 5, 6 or 700 *Pounds* only; to demonſtrate which, one of theſe *Sums* are here wrought by the common *Method*, viz. *H*'s Part, which is done above *Decimally* with leſs than 20 *Figures* in all, whereas the other takes up more than 200: In the one, there is only a ſmall *Multiplication* of 5 *Figures* by 1 *Figure*; in the other there is 8 much larger *Multiplications*, and 1 very large *Diviſion*, and three ſmall ones; by reaſon whereof 'tis more than fifty to one that there is an Error committed in the *Vulgar* Way, before the *Decimal* Way.

If L.3689 : 15 : 5 give L.1739 : 13 : 8 ½ what will L.700 give.

| 20 | 20 | 20 |
|---|---|---|
| 73795 | 34793 | 14000 |
| 12 | 12 | 12 |
| 885545 | 417524 | 168000 |
| | 4 | |
| | 1670098 | |
| | 168000 | |
| | 13360784000 | |
| | 10020588 | |
| | 1670098 | |

885545) 280576464000 (4 | 316840

885545

885545) 2805764640000 ( 4 | 316840
2656635.....
12 | 79210
1491296
885545
2|0|660|0 : 16
6057514
5313270
330 : 00 : 16
7442440
7084360
3580800
3542180
386200
Remainder is Parts of a *Farthing*.
885545

By this Example you plainly see the Excellence of *Decimals* in all such like Cases, and therefore I would recommend the Study thereof to your serious Consideration; and if it shall so happen, that you shall have occasion for large Calculations often, you will find your self continually eas'd of a vast Load of Trouble thereby, which will sufficiently recompence the Labour you'll be at to gain the Mastery of this most exquisite Branch of *Arithmetick*. By the like Method Ships Parts, *&c.* may be valued; as for *Example*, *Suppose a Ship divided into* 32 *Parts, and the Total Value was* L. 1856 : 16, *which were purchased by the following Persons*, viz.

| | 32 | |
|---|---|---|
| *A* | 6 | What is the Value or Cost |
| *B* | 10 | of each Man's Part? |
| *C* | 4 | |
| *D* | 3 | |
| *E* | 9 | |
| Total | 32 | |

As 32 Parts is to L. 1856,8, ſo is 1 Part to L. 58,025 3

which multiply'd by the Number of Parts or Shares each Perſon has, gives the Value or Amount thereof; as you ſee done in the Margin.

| | |
|---|---|
| *D* | L. 174,075 |
| *A* | L. 348,150 |
| *E* | L. 522,225 |
| *C* | L. 232,100 |
| *B* | L. 580,250 |
| Total | L. 1856,800 |

In the caſting up Diviſions of Bankruptcies, 'tis common to caſt up the Amount *per* Pound, and to pay ſomewhat leſs than the whole, to defray ſmall contingent Expences, ſuch as Meetings at the Tavern about the Diviſions, ſmall Preſents to the Attornies or Clerks for adjuſting the Claims, *&c.* and therefore commonly pay even Shillings, Sixpences or Threepences. As, ſuppoſe in the former Queſtion, as the Sum to be divided, would not come to 6*d.* they paid 9*s.* and 3*d.* *per* Pound: Some would chooſe to caſt up the ſeveral Claims by *Practice*, as follows,

*L.* 313 : 7 : 3 at 9*s.* 3*d.* *per* Pound *Sterl.*

| | |
|---|---|
| 5*s.* $\frac{1}{4}$ *L.* | 78 : 6 : 9 $\frac{1}{4}$ |
| 4*s.* $\frac{1}{5}$ — | 62 : 13 : 5 $\frac{1}{4}$ $\frac{5}{3}$ |
| 3*d.* $\frac{1}{16}$. 4*s.* | 3 : 18 : 4 -- 1 - $\frac{1}{12}$. |
| | 144 : 18 : 7 -- 4 - 12, or *L.* 144 : 18 : 7 $\frac{12}{80}$ |

Or, L. 313 : 7 : 3

| | |
|---|---|
| 4*s.* $\frac{1}{5}$ L. | 62 : 13 : 5 $\frac{1}{2}$ |
| — ditto | 62 : 13 : 5 2 |
| 1*s.* $\frac{1}{4}$ of 4*s.* | 15 : 13 : 4 1 $\frac{4}{3}$ |
| 3*d.* $\frac{1}{4}$ of 1*s.* | 3 : 18 : 4 - 1 $\frac{1}{4}$ |
| Anſ. | 144 : 18 : 7 1 $\frac{1}{4}$ or L. 144 : 18 : 7 $\frac{12}{89}$ or $\frac{12}{20}$ (of a *Far.* |

Which

Which by the *Decimal* Way would ſtand thus:

L. 313,3625
52 64

125345
188 02
6 27
1 57

144,931, or L.144: 18: 7 $\frac{1}{2}$

which is about a *Farthing* too much; but as both the *Decimals* are perfect, if you multiply both the Factors together at full length, without contracting, the Product will come out exactly the ſame as above, thus,

313,3625
4625

15668125
6267250
18801750
12534500

144,93015625
20

18|60312500
12

7|23750000
4

|95000000

* I have found the Value of this *Decimal* in the *Product*, by the *Rule*, Page 176, for the ſake of Exactneſs, and not by the *Rule*, Page 203, which is not quite ſo perfect.

Here you ſee that it comes to L. 144: 18: 7 and $\frac{21}{100}$ Parts of a *Farthing*, which is equal to $\frac{1}{2}^2$, the ſame as above. Thus you ſee the Objection made by ſome, that *Decimals* will not anſwer ſo correctly as the common Method, is only for want of due Skill to know how to manage them: Indeed ſometimes the *Contractions* will be a Trifle *defective* or *abundant*, if you retain only three *Figures* in the *Decimal*

*Part* of the *Product*; but if you retain 4 or 5 Places 'twill ſeldom differ half a *Farthing* from the Truth; a Matter too ſmall in *Buſineſs* to take Notice of, as appears by the laſt *Example*, keeping four Figures in the Product.

313,3625
5 2640

1253 450
188 017
6 267
1 567

L. 144,9301, or L. 144 : 18 : 7 $\frac{1}{2}$

which is but the $\frac{1}{10}$ Part of a *Farthing* too much by the *Rule* of *Inſpection*, Page 203, and ſcarce enough by the exact Rule of *Multiplication*, Page 176.

I have already obſerv'd, that in practical Buſineſs, *Fellowſhip* with *Time* is ſeldom or never uſed; yet to obviate all Objections to this Work, I will ſhew you how to perform ſuch like Queſtions, if they ſhould be inſiſted on, *viz.*

### In FELLOWSHIP *or* COMPANY *with Time.*

*You muſt multiply each Man's Stock by his Time, and add theſe Products together, and ſay, As the Total Amount of the Products is to the whole Gain or Loſs, ſo is each particular Product to the Gain or Loſs of each Partner, for the Time his Stock has been employ'd.*

### *EXAMPLE.*

*Suppoſe* A *puts in* L. 100 *for* 6 *Months, and at the End of that Time makes it up* L. 169, *for the whole Voyage*; B *puts in* L. 320 *for* 8 *Months, and at the End of that Time is permitted to take out* L. 120 *by Draft upon their Factor, and leaves the Remainder in for the whole Voyage*; C *puts in* L. 95, *and at three Months End he puts in* L. 75 *more*; *and* 9 *Months after that, puts in* L. 127 *more, they all agree to divide the Loſs or Gain of the whole Voyage in Proportion to their reſpective Stocks and Time.* Query, *What muſt each have, ſuppoſing that at the End of* 21 *Months their Factor makes them a Remittance of* L. 1000 *for the Balance of their then Account Current?*

I have made this *Question* as complicated as moſt are, on purpoſe to ſhew you as much Variety in one, as are uſually found in many; and I will explain every Part neceſſary very fully, and then every Purpoſe, I preſume, will be anſwer'd by this one *Example*, as well as by ſeveral.

*A* L. 100 for 6 Months.

6

600

169 for 15 Months,

15

845

169

2535

3135 *A*'s Total for 21 Months.

*B* L. 320 for 8 Months.

8

2560

200 for 13 Months.

13

2600

5160 *B*'s Total for 21 Months.

*C* L. 95 for 3 Months.

3

285

175 for 9 Months.

9

1575

302 for 9 Months.
9

2718

4578 *C*'s Total for 21 Months.
5160 *B*'s Total.
3135 *A*'s Total.

Their whole Total is 12873 for the whole Time.

By the Queſtion, you ſee *A* has L. 100 for 6 Months, which multiply'd by that Time, and the Product, is 600; then he put in L. 69 more, which remains to the End of the Time, *viz.* 15 Months longer; the Total of the two Sums put in, is L. 169, which continued in Stock 15 Months; and this Product added to the former, makes 3135 for *A*'s whole Stock and Time. *B* puts in L. 320, which multiplied by 8, the Months it continued in Stock, gives 2560 for the firſt Part of his Stock and Time. Now it may be ſuppos'd that the Ship or Cargo was in Whole or in Part diſpos'd of, and that *B* might want L. 120 to be employ'd by their common Factor, upon his own private Account and Riſque, which he has the Conſent of the reſt of the Partnerſhip he ſhall withdraw; and therefore his remaining *L.* 200 is multiply'd by 13 Months, which is the Reſidue of the Time before the Account is made up; and this Product added to the other, makes 5160 for his whole Stock and Time. *C*'s firſt Part, or L. 95 muſt be multiply'd by 3, the Months 'twas employ'd alone; then L. 170, the Sum of 95 and 75 muſt be multiply'd by 9 Months, the Time the firſt increaſed Stock continued; and then L. 297 the whole Stock muſt again be multiply'd by 9, the remaining Part of the 21 Months; and theſe 3 Products make 4578, which three Totals make in all 12873. Now the Sum receiv'd is L. 1120, *viz.* L. 120 by *B* at 8 Months End, and L. 1000 the Balance of the whole Account; then, I ſay,

As 12873 is to L. 1120, ſo is 3135 to *A*'s Part.
— — — — 5160 to *B*'s Part.
— — — — 4578 to *C*'s Part.

Here

Here you may find the common Multiplier, which will be ,0870038, which multiply by the respective Parts of *A*, *B* and *C*, and you will have the following Answers.

0870038
3135

4350190
2610114
870038
2610114

272,7569130 *A*'s Part.

,0870038
5160

52202280
870038
4350190

448,9396080 *B*'s Part.

,0870038
4578

6960304
6090266
4350190
3480152

| | | |
|---|---|---|
| 398,3033964 | *C* or L. | 398 : 6 : $0\frac{1}{4}$ |
| 448,9396080 | *B* | L. 448 : 18 : $9\frac{1}{2}$ |
| 272,7569130 | *A* | L. 272 : 15 : $1\frac{1}{4}$ |
| Total 1119,9999174 | or | L. 1120 — |

This *Total* wants only about $\frac{1}{20}$ Part of a *Farthing* in the *Decimal*.

12873 | 1120, &c. 0 (,087 0038 common *Multiplier.*
102984

90160
90112

49000
38619

103810
102984

826 Remains.

3135
,087

272,745 *A* 21945
448,920 *B* 25080
398,286 *C* 272,745

1119,951 Total. 5160
,087

Here wants almoſt a Shilling; ſo that its plain the Multiplier was not large enough. 36120
41280

448,920

4578
87

32046
36624

398,286

272,756

272,765 *A*.
448,939 *B*
398,303 *C*

1119,998 Total.

Or you may do it thus, by the contracted *Method*.

,0870038
5313

261011
8700
2610
435

272,756 *A*'s Part.

,0870038
0615

435019
8700
5220

448,939 *B*'s Part.

,0870038
8754

348015
43502
6090
696

398,303 *C*'s Part.

Here, by this contracted *Method*, the *Total* wants almoſt two *Farthings*; but each particular Man's Share wants leſs than a *Farthing*: 'Tis frequent alſo to work with a Part of the common *Multiplier*, eſpecially when 'tis either very large, or has Cyphers in the Middle of it, as before, in Page 274.

Or, you may do it by the Vulgar Method thus:

*Stock and Time. Prin. and Gain. Stock and Time.*

As, 12873 is to L. 1120 so is *A*'s 3135 to

3135

62700

3135

3135

*L. s. d.*

12873) 3511200 (272 : 15 : 1 ½.

25746

93660

90111

35490

25746

9744 Parts of a *L.*

20

194880

12873

66150

64365

1785 Parts of a *Shilling.*

12

21420

12873

8547 Parts of a *Penny.*

4

34188

25746

8442

Remains ——— Parts of a *Farthing.*

12873

If

If 12873 — L. 1120 — 5160 *B's* Part.

5160

67200
1120
5600

| | | *L.* | *s.* | *d.* |
|---|---|---|---|---|
| 12873 | 5779200 | (448 | : 18 | : 9 $\frac{1}{2}$ |
| | 51492 | | | |
| | 63000 | | | |
| | 51492 | | | |
| | 115080 | | | |
| | 102984 | | | |
| | 12096 Parts of a *L.* | | | |
| | 20 | | | |
| | 241920 | | | |
| | 12873 | | | |
| | 113190 | | | |
| | 102984 | | | |
| | 10206 Parts of a *Shilling.* | | | |
| | 12 | | | |
| | 122472 | | | |
| | 115857 | | | |
| | 6615 Parts of a *Penny.* | | | |
| | 4 | | | |
| | 26460 | | | |
| | 12873 | | | |
| | 614 | | | |
| Remains | Parts of a *Farthing.* | | | |
| | 12873 | | | |

If

If 12873 — L. 1120 — 4578 *C*'s Part.

1120

91560
4578
4578

| | L. | s. | d. |
|---|---|---|---|
| 12873) 5127360 | (398 : | 6 : | 0 ¼ |

38619

126546
115857

106890
102984

3906 Parts of a *L.*

20

78120
77238

882 Parts of a *Shillings.*

12

10584 Parts of a *Penny.*

4

42336
38619

3717 Parts of a *Farthing.*

12873

| | | | | |
|---|---|---|---|---|
| L. 272 | : 15 | : 1 ½ | 8442 | *A*'s Part. |
| 448 | : 18 | : 9 ½ | 0614 | *B*'s Part. |
| 398 | : 6 | : 0 ¼ | 3717 | *C*'s Part. |
| L. 1120 | : — | : — | —— | Total. |

Here the Whole is done by the common *Method*, which exactly agrees with both the *contracted* and *full Decimals*, saving that *A*'s Part in the *Decimals*, by the Rule of *Inspection*, is made 3 *Farthings*, which by the common Way is but 2 *Farthings*, and about ⅔ of a *Farthing*; so that in all Cases where many *Figures* are to be us'd *Decimals* are by much the best.

BAR-

## BARTER

Is another *Branch* or Part of the *Rule* of *Three*, by which the *Merchant* proportions the *Quantity* or *Quantities* of one Sort of *Goods*, that are, or ought to be given in *Exchange*, for the *Quantity* or *Quantities* of another Sort of Goods.

And here the Method of *Computation* is by conſidering the ſeveral Sorts of *Commodities*, to be of ſome certain *Value*, in ſome known Species of *Coin*, us'd by the *Exchangers*; and theſe *Queſtions* may be propos'd both eaſy and ſimple, and alſo very much compounded, as follows, *viz.*

Q. 1. A *has* 50 *Pieces of Cloth, each* 30 *Ells, allowed to be worth* 3*s.* 4*d. per Ell*; B *has Silk worth* 16*s.* 6*d. per* lb. *How much Silk muſt* A *receive for his Cloth?*

Anſwer, 303 lb. $\frac{1}{33}$.

50 Pieces.
30 Ells in a Piece.

3 : 4 is $\frac{1}{6}$ L. 1500 Ells in all.

L. 250 the Value of the Cloth.

If 16 *s.* 6*d.* *buy* 1 lb. *of Silk, What will* L. 250 *buy?*

2 — 40 lb.

33 Sixpences. — 33) 10000 (303 $\frac{1}{33}$
90
100
99
1

lb.
Anſ. 303 $\frac{1}{33}$ — *Silk* muſt be given for all the *Cloth*.

Here you firſt find the *Value* of all the *Cloth* by *Practice*, which amounting to juſt L. 250, by the *Rule* of *Three*, you ſay, If 16 *s.* 6*d.* buy 1 lb. *Silk*, *What will* L. 250 *buy*, *which produces* 303 $\frac{1}{33}$? So that a *Bale* of *Silk* that weighs 303 lb. $\frac{1}{33}$, and a *Pack* of *Cloth* containing 50 Pieces, condition'd as in the *Queſtion*, are exactly equal in *Value* to one another; the like is to be obſerv'd in all other Caſes, regard being had to the particular Circumſtances attending them. As ſuppoſe,

Q. 2. C *has a Parcel of Shalloons, worth in ready Money,* L. 2 : 6 : 6 *per Piece, for which* D *offers a Parcel of Stockings at* L. 3 : 7 : 6 *per Dozen*; *but ſays* C, *as I can't rea-*

*dily diſpoſe of the Stockings, they being too dear, I will not comply, unleſs I may be allowed to rate my Shalloon at* L. 4 : 04 *per Piece, which the other agreeing to,* Query, *What was the Stockings rated at in ready Money?* Anſ. L. 1 : 17 : 4¼ *per Dozen.*

As L. 4,2 is to L. 2,325, ſo is L. 3 : 375

1,4 | 2,775 | 3,775

16875
23625
23625

1,4) 2,615625 | 1,86830

14

121
112

95
84

116
112

42
42

5 Remains.
14

Here I ſay, As the *Barter* Price of the *Shalloon* is to the ready *Money* Price, ſo is the *Barter* Price of the *Stockings* to the ready *Money* Price: In which all the odd *Monies* being made, or turn'd into *Decimals*, I abbreviate the firſt and ſecond *Numbers*, by dividing by 3, and then working with the remaining Numbers, the Anſ. comes out L. 1 : 17 : 4¼ by the common Computation of *Decimals* by Inſpection, which is above half a Farthing too little; the true and exact Anſwer being L. 1 : 17 : 4 : 1 *Far.* and ⅘ of a *Farthing*, which is ſomewhat more than half a *Farthing* more than the above *Anſwer*; but, as already has been ſaid, no Buſineſs can be tranſacted nearer than a *Farthing* in actual *Payments*; therefore ſuch firſt Anſwer is ſufficient for any real *Buſineſs*.

There are a great many Ways of varying theſe Sort of *Queſtions*: As, ſuppoſe this laſt, where you may imagine *D* gave the Price mention'd, *viz.* L. 3 : 7 : 6 per *Dozen* for the *Stockings*, and that *C* could eaſily ſell them for ſo much, and that the *Shalloon* was really worth, or could be ſold only for L. 2 : 6 : 6 per Piece; then you may enquire the whole *Gain* or *Loſs* of each *Perſon*. After you have aſcertain'd the *Quantity* of each Sort of *Goods*, or you may

may enquire the *Gain* or *Loſs* per *Cent.* or per *Dozen*, &c. As under theſe Circumſtances *D* will loſe *L.* 1 : 10 : 1¼ per *Dozen* by his *Stockings*, and *C* muſt gain L. 1 : 17 : 6 per *Piece* by his *Shalloons*, and by every *Hundred Pounds* worth of *Stockings*, that *D* ſells or *barters* at this *Price* or *Rate*, he muſt loſe L. 80 : 12 : 11, that is, the Goods that he receives by this *Barter*, and ſells for *L.* 100, coſt him really L. 180 : 12 : 11, as may be tried by the two different Ways following, *viz.*

If L. 1,8683 loſes L. 1,5067, *What loſes* L. 100?
Anſ. L. 80,645, *&c.* or L. 80 : 12 : 11.
Or, If L. 2,325 gain L. 1,875 L. 100?
Anſ. L. 80 : 12 : 11.

By the foregoing Work it appears that *D* loſes L. 1,5067 per *Dozen* by the *Stockings*, and conſequently that for L. 180 : 12 : 11, he receives but L. 100; ſo that he loſes L. 80 : 12 : 11 by every L. 100 he ſo receives; and on the other hand, *C* gains ſo much by every L. 100 of his Goods he delivers, more than the prime Coſt, becauſe for what is really worth but L. 100, he receives the Value of L. 180 : 12 : 11. Now this laſt Part of the Work is what is properly call'd *Loſs* and *Gain*; and is by ſome made a diſtinct Rule.

Q. 3. *Suppoſe* A *has* 50 *Dozen of Hats, worth* 7 *s.* 6 *d. per Hat, for which* B *offers him Handkerchiefs, worth* 22 *s. a Dozen; but* A *will not agree, unleſs he may rate his Hats at* 8 *s. a Piece.* Query, *How muſt* B *rate his Handkerchiefs per Dozen, to advance the Price or Rate equally?*

Anſwer, at L. 1 : 3 : 5½ and the ¼ Part of a Farthing per Dozen: For,

If 7 *s.* 6 *d.* or ,375 be 8 *s.* or ,4, *What will L.* 1,2 *or L.* 1,1 *be?*

,375) 4,4 (1,1733, *&c.*
575
650
375
2750
2625
1250
1125
125

Or, 15 — 8 — 44
8

| | s. | d. | Far. |
|---|---|---|---|
| 15 \| 352 | 23 | 5 | 2 and $\frac{4}{7}$ |

30

52
45

7
12

84
75

9
4

36
30

6

or $\frac{6}{15}$

If the Value of the *Decimal* ,1783, *&c.* be exactly found by the Rule, Page 176, and proper Allowances made for its being a *Repetend*, both Ways will perfectly agree; as appears from what follows, *viz.*

,1783
20

3 | 4666
12

5 | 6000
4

2 | 4000

Here the firſt *Product* is 3,4666, *&c.* for as the *Repetend* would go on infinitely, the *Cypher* in the *Multiplier*, in a *finite Number* of Figures, will not take Place; but the *Product*

*duct* must be all 6's, from the Beginning of the *Repetend* to the End of the Number of Figures the *Decimal* is to have Places; then by the Rule, Page 187, the Product of the 12 will be 5,6000, a *Finite Number*, and that multiply'd by 4, gives 2,4, a *Finite Number*, for the *Product*, the 0's signifying nothing, the 2 being cut off for 2 *Farthings*; the 4 is $\frac{4}{10}$ or $\frac{2}{5}$ of a *Farthing*, as *per* the Vulgar Method.

Q. 4. *Suppose* A *has a Parcel of* Wool, *worth* L. 5 *per* C. *ready Money, and* B *has* Broad Cloth, *worth* 13 *s.* 4*d. per Yard, which he offers* A *for his* Wool; *to which* A *replies, I will not consent, unless you allow me* L. 6 *per* C. *for my* Wool, *and pay me* $\frac{1}{3}$ *Part* ready Money; *if you comply with this, I will take your* Cloth *at a Price proportionable.*

Query, *What must* B *rate his* Cloth *at per Yard, and what Quantity of* Money *and* Cloth *must* B *give* A *for a* Ton *of* Wool, *upon these Conditions?*

Here I first find the Value of a *Ton* of *Wool*

| | | |
|---|---|---|
| at L. 6 per C. to be - - - | L. | 120 |
| from which *subst.* $\frac{1}{3}$ for *ready Money*, which is | L. | 40 |
| and the *Remain.* is the *Amount* of the *Cloth*, viz. | | 80 |

But before I can know the *Quantity* of the *Cloth*, I must know the *Rate* it is to be valued at. Now it appears by what is above, that *A* gains L. 20 by his *Ton* of *Wool*, and *B* must gain L. 20 by selling L. 80 Worth of *Cloth*, because he pays L. 40 *ready Money*. Therefore *deducting* L. 20 from L. 80, the *Remainder* is L. 60: Then I say, As L. 60, the real Value of the *Cloth*, is to L. 80, the advanc'd Value; so is 13 *s.* and 4*d.* the *ready Money* Price of a *Yard*, to 17 *s.* 9*d.* $\frac{1}{3}$ the *advanced* Price, which being wrought by the contracted Method will stand thus:

6 | 0 — 8 | 0 — 13,4

4,5 $\frac{1}{3}$

3 | — 4 |

3

17,9 $\frac{1}{3}$

1

Or you may *substract* the *Money* paid *A* both from the true and advanced Price of his *Wool*; and say, As the lesser *Remainder* 3, is to the greater *Remainder* 4; so is the *ready*

*Money* Price of a *Yard*, 13 *s.* 4 *d.* to the advanced Price, 17 : 9 ⅓, as before.

*Viz.*

L. 6 the *advanced* Price of C. of *Wool*.
2 the ⅓ *ready Money* paid.

4 the *advanced* Price for the Remainder.

L. 5 the *true* or *ready Money* Price of C. of *Wool*.
2 the *ready Money* paid.

3 the *ready Money* Price exchanged.

| | *s.* | *d.* | |
|---|---|---|---|
| As L. 3 *ready Money* is to L. 4 *exchange*, so is | 13 | 4 | the *ready Money* Price of a *Yd.* to |
| | 4 | 5 ⅓ | 17 *s.* 9 *d.* ⅓, the *advanc'd* Price. |
| | 17 | 9 ⅓ | |

In this, and all such like Cases, you may reduce the first and second, or first and third *Terms*, as *low* as possible; as you see done by the 60 and 80, in the first *Method*, which are reduc'd to 3 and 4; and in the second *Method*, they are in the *lowest Terms*, viz. 3 and 4; then *divide* the *second Term* by the *first*, and the *Quotient* is the *Multiplier* of the third *Term*, whose *Product* is the *Answer* to the *Question*: As in both the *Methods* above, the *Quotient* is 1 ⅓, by which *multiplying* the third *Number*, 13 *s.* 4 *d.* and the *Product* is 17 *s.* 9 *d.* ⅓.

Now then to find the Quantity of *Cloth* to be delivered, I say,

If 13 *s.* 4 *d.* or L. ⅔ buy 1 Yard, *What will* L. 60?

3

2 | 180

Ans. 90 *Yards*.

So that *B* must give *A* L. 40 in *Money*, and 90 *Yards* of *Cloth* for a *Ton* of *Wool*. Now to know the Truth of this Answer, you are to observe, that the *Quantity* of *Cloth* and *Money* must be the same, whether you consider the *Wool* advanc'd in *Price* or no; because 'tis agreed, that in Consideration of paying so much *ready Money*, the *Cloth* was to be

be advanc'd proportionably, ſo as to make neither Party Gainer or Loſer; ſo that if you ſay,

If 17 *s.* 9*d.* ½ *buy* 1 *Yard*, *What will L.* 80 *buy?* You will have 90 *Yards* for the *Anſwer*, as you may eaſily try; for the more *ready Money* is paid, the more muſt the *Price* of the *Cloth* be *advanced*; becauſe by *Money*, nothing is to be ſuppos'd *gain'd* or *loſt*.

Q. 5. A *has* Tin *worth* 50 *s. per* C. ready Money, *but in* Barter *he will have L.* 3 : 6 : 8, *and moreover inſiſts upon gaining L.* 10 *per* Cent. *over and above the Advance, and that he will have* ½ ready Money; B *has Lead worth* 14 *s per* C. ready Money: *To how much muſt he advance his* Lead, *to comply and barter upon equal Terms with* A?

Anſwer, B muſt rate his Lead at L. 1 : 18 : 6 per C.

Another Part of the *Rule* of *Three*, is that Part of *Barter* commonly called

## *EXCHANGE.*

And this more immediately relates to negotiating the *Monies* of one *Kingdom* or *Country*, for, or with another, either according to the real Values that they bear to one another; or, according to the Advantage or Diſadvantage that one *Country* is in, with relation to its *Trade*, *War*, &c. to another; for though all *Countries*, that keep or make their *Coin* or *Money* of one certain Fineneſs of *Gold* or *Silver*, bear an exact Proportion to one another, and this Proportion is called the *Par*; yet the *Exchange* to or from one *Country* and another, very ſeldom is at that *Rate*; and 'tis obſervable that the moſt Trading *Countries* have commonly the Advantage of the *Exchange* in their Favour.

*Note*, 'Tis a ſure Sign of a proſperous *Trade*, when the Courſe of *Exchange* is above the *Par*, and the contrary when 'tis below it; and as the current *Coins* of almoſt all *Kingdoms* differ, both in their *Names* and *Species*, ſo do alſo their *Weights* and *Meaſures*; tho' in the true Nature of the Thing, they muſt all neceſſarily be reduced to ſome one common *Meaſure*, *Standard* or *Par*, before the real intrinſick Value can be aſcertained. As for Inſtance, a *Dutch* or *Flemiſh Ell* is found, by comparing them together, to be ¾ of our *Yard*, or ⅘ of our *Ell*; and a *French Aulne* or *Ell* is ⅘ or 1 ½ of our *Yard*, and ⅘ or 1 ½ of our *Ell*; which Proportions muſt be known before any one can pretend to *trade* with the *People* of thoſe *Countries*, for the *Commodities* meaſured by thoſe *Meaſures*, with any Degree of Regularity or

Certainty. The like is to be obſerv'd of the *Weights* and *Coins*. Having premis'd thus much, next ought to follow ſome *Tables*, that expreſs the *Par* or *Proportion* between the *Weights*, *Meaſures* and *Coins* of the moſt noted publick trading *Cities*; for which purpoſe I have extracted a few from the beſt extant, but find ſo many Differences and Defects among them, that 'tis with much Caution any of them can be depended on. However, the moſt correct, I think, are theſe that follow.

| *Dutch Money.* | *Engliſh Money.* L. s. d. f. | *Dec.* |
|---|---|---|
| 1 *Pennick* is - - - | 0 : 0 : 0 $\frac{1}{40}$ | ,0003125 |
| 8 *Pennicks* is 1 *Groot*, which is L. | 0 : 0 : 0 $\frac{4}{5}$ | ,0025 |
| 2 *Groots* is a *Stiver*, or - - | 0 : 0 : 1 $\frac{2}{5}$ | ,005 |
| 6 *Stivers* is 1 *Shilling*, or - - | 0 : 0 : 7 $\frac{1}{5}$ | ,030 |
| 20 *Stivers* is one *Guilder*, or - | 0 : 2 : — | ,1 |
| 6 *Guilders* is 1 *Flemiſh Pound*, or | 0 : 12 : — | ,6 |
| 10 *Guilders*, or 33 *s.* 4 *d. Flem.* is | 1 : - : — | 1, |
| A common *Dollar* is - - | 0 : 3 : — | ,15 |
| A *Specie Dollar* is - - | 0 : 5 : — | ,25 |

This *Table* exhibits the intrinſick Value of the *Coins* of the Places where they are uſed, expreſſed in *Britiſh* or *Sterling* Money at the exact *Par*; and upon account of the Fractional-Parts the *Dutch* ſeldom or never uſe *Decimal Arithmetick*, tho' the Calculations will never vary from the Truth, if rightly and judiciouſly perform'd, as you ſhall hereafter ſee: But tho' the above be the true *Proportions* of the ſaid *Coins* to one another, yet the *Exchange* is ordinarily made higher upon account of having the *Money* paid in *Bank*, and not current *Money*, the Trouble of keeping *Accounts*, the Safety of Conveyance by the Poſt in *Bills* of *Exchange*, and ſaving Charges of Carriage from one Place to another, &c. But if you are minded to convert any Species of *Engliſh* into *Dutch Money*, or contrarily, you may work after ſome of the following Manners. As,

*Suppoſe I would know how many Pounds* Flemiſh *were in* 100 Sterling?

*L. Ster. Flem. L. Ster. Flem.*

Say, as 3 is to 5, ſo is 100 to 166 : 13 : 4

5

500

L. 166 : 13 : 4

By

By the above *Table* you see, that 10 *Guilders*, or 33 *s.* 4 *d.* *Flemish* is one Pound *Sterling*, that is, L. 1 $\frac{2}{3}$ *Flem.* is equal to L. $\frac{1}{1}$ or L. 1 *Sterling*; wherefore reducing the mix'd *Number* 1 $\frac{2}{3}$ to a compound *Fraction*, 'twill be $\frac{5}{3}$; then making L. 1 *Sterling* a *Fraction*, that has the same *Denominator*, viz. $\frac{3}{3}$, and rejecting the common *Denominator*, the *Numerators* are the whole *Numbers* that exactly express the Proportion between a *Pound Flemish* and a Pound *Sterling*, as above, *viz.* 5 and 3, or 3 and 5.

*Or you may say,*

As L. 1. *Sterling* is to 10 *Guilders*, so is L. 100. *St.* to 1000 *Guil.* And as 6 *Guil.* make a L. *Flem.* 100 divid. by 6 gives 166 $\frac{4}{6}$ L. *Fl.*

You are likewise to observe, that the *Dutch* do also compute their *Money* like the *English*, by 20 *Schillings* to the *Pound*, and 12 *Pence* to the *Schilling*; so that in reality their *Schilling* is equal to $\frac{3}{5}$ of our *Shilling*, or 8 of our *Pence*, &c. when computed at *Par*.

2. *In* L. 365 13 *s.* 6 *d.* Sterling, *How many Guilders* Dutch *Money? also, How many L. s. d.* Dutch *or* Flemish?

L. 365,675 *Sterling.*
10 *Guilders* in a *Pound.*

Answer 3656,750 *Guilders*, or 3656 *Guilders* and $\frac{3}{4}$.

Or 3656 *Guilders*, 2 *Schillings* and 3 *Stivers.*

Or you may do it thus:

L. 365 — 10

3650 *Guilders.*
6 ditt. in 12 *Shillings.*

*Guilders* 3656 : 2 : 3 add the 2 *Schillings* and 3 *Stivers*, found to be 18 *Sterl.* and the Whole will be as above.

1 *s.* 6 *d. rem.* or 18 Pence. — 5

36 | 90 | 2 *Schillings.*
72

6 | 18 | 3 *Stivers.*
| 18 |

0

Or, by the foregoing *Table*, 'tis plain, that 5 *Stivers* is equal to one of our *Six-pences.* Now as the *Remainder* above is 1 *s.* 6 *d.* or 3 *Six-pences*, which is 15 *Stivers*, and that is 2 *Schillings* and 3 *Stivers*, the same as above.

But

But tho' at any Time the *Exchange* ſhould be either above or below *Par*, the *Subdiviſions* of the *National Money* remain the ſame as when the *Exchange* is at *Par*; only there is a greater or leſſer Number of Pounds *Sterling* or *Flemiſh* given, for the *Sum* exchanged, according to the *Rate* the Courſe runs at. As, ſuppoſe,

3. *I want to remit* L. 500 *from* London *to* Amſterdam, *and the* Courſe *of* Exchange *was at* 34 *s.* 6 *d.* Flemiſh *for a* L. Sterling, *How much muſt I receive in* Amſterdam?

This *Queſtion* may be done either by the common *Rule of Three*, *Practice* or *Decimals* as follows.

If L. 1. *Sterl.* is L. 1 : 14 : 6 *Flemiſh* L. 500 *Sterl.*
40 *Six-pences* in a L.

69
500

4|0|345|0|0 *Flemiſh* Six-pences.

L. 862 : 10 *Anſwer.*

Or *Decimally*, thus:

L. 1,725 equal to L. 1 : 14 : 6 *Flemiſh.*
500 *Sterling.*

L. 862,500, or L. 862 : 10 *Flemiſh.*

By *Practice*, thus:

L. 1 : —— is L. 500 *Sterl.* at L. 1 : 14 : 6 *Flem.* per L. *Sterl.*
: 10 *s.* is $\frac{1}{2}$ L. and is 250
4 *s.* is $\frac{1}{5}$ L. and is 100
—6 *d.* is $\frac{1}{8}$ of 4 *s.* and is 12 : 10

L. 1 : 14 : 6 *Total* is L. 862 : 10 *Flemiſh.*

Any of theſe Ways will perfectly anſwer the *Queſtion*; but you may perceive the *Decimal Way* is both the ſhorteſt and eaſieſt; for after a little Practice, you will readily be able to turn any odd *Money*, or *s.* and *d.* whether *Dutch* or *Engliſh*, into *Decimals*, without uſing any *Table*; for as the *Subdiviſions* are the ſame, the *Decimal Figures* will be the ſame, tho'

tho' not of the ſame intrinſick *Value*, yet of the ſame relative *Value*; for 'tis the Property of *Decimal Fractions*, as well as Vulgar *Fractions*, to expreſs the ſame Part of any *Unit* by the ſame *Numerical Figures*, tho' the Application may be of diverſe *Species* and *Values*: As for Inſtance, ½ may ſtand for 2 *Farthings*, 4 *Furlongs*, or 2 *Quarters* of a *Yard*, &c. according as a *Penny*, a *Mile*, or a *Yard* may be the *Integer*; and ſo *Decimally*, the ſame Part, *viz.* one *Half*, let the *Integer* bear what Name it will, is always expreſſed by ,5; and tho' I have formerly intimated this before, yet I thought it convenient to repeat it here again, leſt the *Learner* ſhould have forgot it, or perhaps, might not be ſo well qualified then to underſtand the ſeveral Obſervations before made, as by this Time his further *Practice*, and greater *Skill* in this *Science*, may have render'd him able to take in ſuch Obſervations: And another Reaſon is, that ſome Perſons may read only ſuch Parts of this *Book* as they may immediately want, without deliberately going thro' every Branch of it: And as *Decimal Arithmetick* has not been ſo much ſtudied, and univerſally *practiſed*, as it deſerves, ſome of theſe Hints may be uſeful to thoſe who are but meanly ſkill'd therein, tho' otherwiſe good *Artiſts*.

But as the Denominations of *Guilders*, *Stivers*, &c. are more commonly us'd than *L. s. d.* to anſwer the laſt *Queſtion* in thoſe *Species*, you may work thus. After you have done as before, you may ſet down the Anſwer, *viz.*

L. 862 : 10 *Flemiſh.*
6 *Guilders* is a L. *Flemiſh.*

5175 Anſwer in *Guilders.*

Or you may do thus for the Whole.

*Ster.* *s.* *d.*
L. 500 at 34 : 6 *Flem.* per L. *Sterling.*
6 *Stivers* is 1 *Schilling.*

207 *Stivers* in 34 : 6 *Flemiſh.*
500

2 | 0 | 10350|0 *Stiv.* in all.

Anſ. 5175 *Guilders*, as before.

Or, you may *multiply* the given Number of Pounds *Sterling* by 10, the *Guilders* in a *L. Sterling* at *Par*; and then

| | s. | d. | | d. | *Guilders.* | | s. | d. |
|---|---|---|---|---|---|---|---|---|
| ſay, As | 33 | : 4, | or, | 400 | is to 5000 ſo is the Courſe | | 34 | : 6 |
| | | | | | | | | 12 |
| | | | | | | | | 414 |
| | | | | | | | | 50 |
| | | | | | | 4 \| | 20700 | |
| | | | | | | To | 5175 | *Guild.* |

Or, *Decimally* thus:

| As | *d.* | | | *Guild.* | | 50 is the 2d N° |
|---|---|---|---|---|---|---|
| 33,4 | or 400 | is to | 34,5 | ſo is L. 500 | to 5175 | 1725,0 abbreviated. |
| | | | 3 | 10 | 3 | |
| 1 | | | 103,5 | 5000 | 5175 | *Guild.* |
| | | | 90 | | | |
| | | | 5175,0 | | | |

The Reaſon of the above Proceſs is this, *viz.* 33 *s.* 4*d.* or 400 *d. Flemiſh* is a L. *Sterling* at *Par*, and 5000 are the *Guilders* in L. 500 *Sterling* at *Par*; then ſaying, As 400 *d. Par* is to 34 *s.* 5 *d.* the *Courſe*, ſo is 5000 *Guilders* Par, to 5175 *Guilders* per the *Courſe*; and cutting off ,00 from the firſt and third Numbers, the Remainders are 4 and 50: And in as much as the ſecond Number muſt be *multiply'd* by 12, to bring it into *Flemiſh-Pence*, to make it of the ſame Name with 400 *d.* the firſt Number, inſtead thereof I multiply by 3; becauſe the firſt Number 4, and this 12, being divided by 4, the *Quotients* will be 1 and 3; and by this Means I have nothing more to do with the firſt Number. The like may always be done in all other Caſes, and generally the Work will be very eaſily performed by *Decimals*, let the Courſe be what it will; as ſhall be made more fully to appear by what follows.

*Suppoſe*

*Suppose I have a Bill of* Exchange *from* Rotterdam *for* 4575 Guilders 19 Stivers, *which is to pay* L. 429 : 13 : 4 Sterling, *What is the Exchange reckon'd at?*

Answer, 35 *s.* 6*d.* *Flemish* for a L. *Sterling.*

To do which, I say,

| | *s.* | *d.* | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| As L. 429 $\frac{4}{3}$, or 13 : 4 | | | is to | 4575 | : | 19, | so is | L. 1 | *St.* to 35 *s.* 6*d.* |
| 3 | | | | 20 | | | | 3 | |
| 1289 | | | | 91519 | | | | 3 | |
| | | | | 3 | | (6) | | | |
| | | | | 1289) 274557 | | (213 *Stivers.* | | | |
| | | | | 2578 | | | | | |
| | | | | | | *Sch.* 35 : 3 *St.* or 6*d.* | | | |
| | | | | 1675 | | | | | |
| | | | | 1289 | | | | | |
| | | | | 3867 | | | | | |
| | | | | 3867 | | | | | |
| | | | | 000 Remains. | | | | | |

*Decimally* thus:

| | | | | |
|---|---|---|---|---|
| | | *Guilders.* | | |
| As L. 429,6 | — | 4575,95 | — | 1 |
| 42,9 | | 457595 | | (3) |
| 386,7 | ) | 4118,355 | ( | 10,6,5 |
| | | 3867 | | 35+5 |
| | | 25135 | | |
| | | 23202 | | Or 35 *s.* 6*d.* |
| | | 19335 | | |
| | | 19335 | | |
| | | .... Remains. | | |

*Explanation of the above.*

In the first *Method*, as 13 *s.* 4*d.* is $\frac{2}{3}$ of a L. I only *multiply* or bring the L's into *Thirds*, and the *Guilders* are brought

brought into *Stivers*; then multiplying and dividing, as in common, the Anſwer is 213 *Stivers* for a L. *Sterling*, which divided by 6 gives 35 *s.* 6 *d. Flemiſh.*

In the ſecond or *Decimal Method*, I turn the odd Parts or *Money* into *Decimals*, viz. 429 L's and ϕ, for the Repetend belonging to the 13 *s.* 4 *d.* and 4575 *Guilders*, and 95 Parts for the 19 *Stivers*, which being $\frac{19}{20}$ of a *Guilder* is the ſame as if they were *Shillings*, and conſider'd as Parts of a *Pound Sterling*; and ordering the *Decimals*, as directed Page 198, I *multiply* and *divide* as in *common*, and the *Anſwer* is 10,65 *Guilders* per L. *Sterling*; and as 20 *Stivers* make a *Guilder*, and 6 *Stivers* make a *Schilling*, theſe two Numbers ſet *Fractional-wiſe*, thus, $\frac{20}{6}$ and *abbreviated*, produce $\frac{10}{3}$; ſo that removing the ſeparating *Point* to 106,5, and dividing by 3, the *Quotient* or *Anſwer* is 35,5 or 35 *Schillings* and *Six-Pence Flemiſh* per L. *Sterling*, as before: And thus you ſee the *Decimal* and common *Way* perfectly agree, and the *Work* one Way, is much the ſame in *Quantity* as the other Way; but if the *Sum* had been *extended* to more minute *Parts* of the *Engliſh* Coin, or were thoſe which were not *Aliquot-Parts* of the L. *Sterling*, ſo as the *Abbreviation* could not be made; then the common *Way* would be much more troubleſome and tedious than the *Decimal Way.*

*Suppoſe I am to remit by Bill* L. 785,15 Sterling *from* London *to* Amſterdam, *Exchange at* 34 *s.* 7 *d.* Flemiſh *for a* L. Sterling, *How many* Guilders, Stivers, *&c. muſt be paid in* Amſterdam *for the ſaid Bill?*

Anſwer, *Gl.* 8152 : 3 *Stivers* and 2 *Pennings*; which may be wrought thus, *Decimally.*

| | | |
|---|---|---|
| L. 785,7,5 | 34,7 | *Exchange.* |
| 196,4375 | 33,4 | *Par.* |
| 98,21875 | | |
| | 1,3 | Difference. |
| Anſwer, 8152,15625 | | |

Or,

| *Guild.* | *Sti.* | *Pennings.* |
|---|---|---|
| 8152 : | 3 : | 2 |

Here, after the *Sterling-Money* is expreſs'd in whole *Numbers* and *Decimal-Parts*, you only remove the *Point* one Place more towards the *Right-hand*, and then they are *Guilders*, and *Decimal-Parts* of a *Guilder*, becauſe 10 *Guilders*

is 33 *s.* 4 *d. Flem.* or. 1 L. *Sterl.* at *Par*; then ſubſtracting the *Par*, 33 *s.* 4 *d.* from the *Courſe* of *Exchange* 34,7, and 1,3 or 15 *d.* is the Increaſe or Difference. Now as 400 *Flemiſh-Pence* is a true *Flemiſh-Pound*, or 33 *s.* 4 *d. Ten-Pence* will be the $\frac{1}{40}$ Part thereof; therefore I divide the *Guilders*, &c. by 40, and the *Quotient* is 196,4375; and 5 being the $\frac{1}{2}$ of 10, I divide the laſt *Quotient* by 2, and this *Quotient* is 98,21875; which two *Quotients* being added to 7857,5, the *Guilders* and Parts in the *Sterling-Money* at *Par*, makes 8152 *Guilders*, 15625 Parts, or 8152 *Guilders*, 3 *Stivers*, and 2 *Pennings*; and if you don't know how to Value the ,15625 by Inſpection, you may *multiply* them thus:

,15625 Parts of a *Guilder*.
20 *Stivers* in a *Guilder*.

*Stivers* 3,12500 and Parts of a *Stiver*.
16 *Pennings* in a *Stiver*.

*Pennings* 2,00000

Or you may do thus: for 7857,5 *Guilders*.

| | | *Guild.* | *Stiv.* | *Pennings.* | |
|---|---|---|---|---|---|
| 33 | — ſet down | 7857 | 10 | — | at 33,4 |
| | 10 *d.* is $\frac{1}{40}$ L. | 196 | 8 | 12 | |
| | 5 *d.* is $\frac{1}{2}$ of 10 *d.* | 98 | 4 | 6 | |
| Total 34 : 7 | | 8152 | 3 | 2 | |

That is, inſtead of putting down the ,5 Parts of the *Guilder Decimally*, put it down in *Stivers*, &c. and work as in common Practice, having regard only to the *Subdiviſions* of 20 *Stivers* making a *Guilder*, and 16 *Pennings* making a *Stiver*; and this muſt be your Care, let the *Subdiviſions* be what they will, and apply'd in any Manner, either to *Coins*, *Weights* or *Meaſures*.

Now as the *Low-Countries*, and *England*, have much Negotiation by *Bills* of *Exchange*, I will exhibit a Table by which you may convert *Engliſh* into *Dutch* Money, or *Dutch* Money into *Engliſh* Money, by one ſingle Multiplication; as you may obſerve by what follows.

*s. d.*

| *s.* | *d.* | *Flem.* L's | *Guild.* | *Engliſh* L's. | *Guilders.* |
|---|---|---|---|---|---|
| 32 | — | 1,6 | 9,6 | ,625 | ,1041ℓ, &c. |
| | 0½ | 1,602083 | 9,6125 | ,6241873 | ,1040312 |
| | 1 | 1,6041ℓ | 9,625 | ,6233766 | ,1038961 |
| | 1½ | 1,60625 | 9,6375 | ,6225681 | ,1037613 |
| | 2 | 1,6083 | 9,65 | ,6217617 | ,1036169 |
| | 2½ | 1,61041ℓ | 9,6625 | ,6209573 | ,1034929 |
| | 3 | 1,6125 | 9,675 | ,6201551 | ,1033258 |
| | 3½ | 1,614583 | 9,6875 | ,6193549 | ,1032258 |
| | 4 | 1,61ℓ | 9,7 | ,6185567 | ,1030928 |
| | 4½ | 1,61875 | 9,7125 | ,6177606 | ,1029601 |
| | 5 | 1,62083 | 9,725 | ,6169666 | ,1028277 |
| | 5½ | 1,62291ℓ | 9,7375 | ,6161746 | ,1026957 |
| | 6 | 1,625 | 9,75 | ,6153846 | ,1025641 |
| | 6½ | 1,627083 | 9,7625 | ,6145967 | ,1024328 |
| | 7 | 1,6291ℓ | 9,775 | ,6138109 | ,1023018 |
| | 7½ | 1,63125 | 9,7875 | ,6130268 | ,1021711 |
| | 8 | 1,63 | 9,8 | ,6122449 | ,1020408 |
| | 8½ | 1,63541ℓ | 9,8125 | ,6114650 | ,1019108 |
| | 9 | 1,6375 | 9,825 | ,6106870 | ,1017812 |
| | 9½ | 1,639583 | 9,8375 | ,6099110 | ,1016518 |
| | 10 | 1,641ℓ | 9,85 | ,6091371 | ,1015228 |
| | 10½ | 1,64375 | 9,8625 | ,6083650 | ,1013942 |
| | 11 | 1,64583 | 9,875 | ,6075950 | ,1012658 |
| | 11½ | 1,647916 | 9,8875 | ,6068268 | ,1011378 |
| 33 | — | 1,65 | 9,9 | ,ℓℓ, &c. | ,10, &c. |
| | 0½ | 1,652083 | 9,9125 | ,6052963 | ,1008827 |
| | 1 | 1,6541ℓ | 9,925 | ,6045339 | ,1007556 |
| | 1½ | 1,65625 | 9,9375 | ,6037735 | ,1006289 |
| | 2 | 1,6583 | 9,95 | ,6030150 | ,1005025 |
| | 2½ | 1,66041ℓ | 9,9625 | ,6022584 | ,1003764 |
| | 3 | 1,6625 | 9,975 | ,6015037 | ,1002506 |
| | 3½ | 1,664583 | 9,9875 | ,6007509 | ,1001251 |
| | 4 | 1,ℓ | 10,—— | ,6 | ,1 |
| | 4½ | 1,66875 | 10,0125 | ,5992509 | ,0998751 |
| | 5 | 1,67083 | 10,025 | ,5985037 | ,0997506 |
| | 5½ | 1,672916 | 10,0375 | ,5977584 | ,0996264 |
| | 6 | 1,675 | 10,05 | ,5970150 | ,0995025 |
| | 6½ | 1,677083 | 10,0625 | ,5962733 | ,0993789 |
| | 7 | 1,6791ℓ | 10,075 | ,5955335 | ,0992556 |
| | 7½ | 1,68125 | 10,0875 | ,5947956 | ,0991326 |
| | 8 | 1,683 | 10,1 | ,594ℓ, &c. | ,099ℓ, &c. |
| | 8½ | 1,685416 | 10,1125 | ,5933254 | ,0988876 |

*s. d.*

| *s.* | *d.* | *Flem.* L's. | *Guild.* | *Engliſh* L's. | *Guilders.* |
|---|---|---|---|---|---|
| | 9 | 1,6875 | 10,125 | ,5925926 | ,0987654 |
| | 9½ | 1,688958z | 10,1375 | ,5918619 | ,0986436 |
| | 10 | 1,6916 | 10,15 | ,5911330 | ,0985222 |
| | 10½ | 1,69375 | 10,1625 | ,5904,&c. | ,0984, &c. |
| | 11 | 1,6958z | 10,175 | ,5896805 | ,0982, &c. |
| | 11½ | 1,697916 | 10,1875 | ,5889571 | ,0981595 |
| 34 | — | 1,7 | 10,2 | ,5882353 | ,0980392 |
| | 00½ | 1,702083 | 10,2125 | ,5875153 | ,0979192 |
| | 1 | 1,7041 6 | 10,225 | ,5867971 | ,0977995 |
| | 1½ | 1,70625 | 10,2375 | ,5860805,&c. | ,0976809, &c. |
| | 2 | 1,708z | 10,25 | ,5853658,&c. | ,0975609, &c. |
| | 2½ | 1,710416 | 10,2625 | ,5846529 | ,0974755 |
| | 3 | 1,7125 | 10,275 | ,5839416 | ,0973236 |
| | 3½ | 1,714583 | 10,2875 | ,5832321 | ,0972054 |
| | 4 | 1,716 | 10,3 | ,5825243 | ,0970874 |
| | 4½ | 1,71875 | 10,3125 | ,5818182 | ,0969697 |
| | 5 | 1,720833 | 10,325 | ,5811138 | ,0968523 |
| | 5½ | 1,722916 | 10,3375 | ,5804111 | ,0967352 |
| | 6 | 1,725 | 10,35 | ,5797102 | ,0966184 |
| | 6½ | 1,727083 | 10,3625 | ,5790110 | ,0965018 |
| | 7 | 1,729166 | 10,375 | ,5783134 | ,0963856 |
| | 7½ | 1,73125 | 10,3875 | ,5776174 | ,0962696 |
| | 8 | 1,733 | 10,4 | ,5769230 | ,0961538 |
| | 8½ | 1,735416 | 10,4125 | ,5762305 | ,0960384 |
| | 9 | 1,7375 | 10,425 | ,5755396 | ,0959233 |
| | 9½ | 1,739583 | 10,4375 | ,5748503 | ,0958084 |
| | 10 | 1,7416 | 10,45 | ,5741627 | ,0956938 |
| | 10½ | 1,7475 | 10,4625 | ,5734767 | ,0955794 |
| | 11 | 1,745833 | 10,475 | ,5727924 | ,0954654 |
| | 11½ | 1,747916 | 10,4875 | ,5721096 | ,0953516 |
| 35 | — | 1,75 | 10,5 | ,5714285,&c. | ,0952381 |
| | 00½ | 1,752083 | 10,5125 | ,5707491 | ,0951248 |
| | 1 | 1,7541 6 | 10,525 | ,5700713 | ,0950119 |
| | 1½ | 1,75625 | 10,5375 | ,5693950 | ,0948992 |
| | 2 | 1,758z | 10,55 | ,5687204 | ,0947867 |
| | 2½ | 1,760416 | 10,5625 | ,5680473 | ,0946745 |
| | 3 | 1,7625 | 10,575 | ,5673759 | ,0945626 |
| | 3½ | 1,764583 | 10,5875 | ,5667060 | ,0944510 |
| | 4 | 1,766 | 10,6 | ,5660377 | ,0943396 |
| | 4½ | 1,76875 | 10,6125 | ,5653710 | ,0942285 |
| | 5 | 1,770833 | 10,625 | ,5647058 | ,0941176 |
| | 5½ | 1,772916 | 10,6375 | ,5640423 | ,0940070 |

| *s.* | *d.* | *Flem.* L's. | *Guild.* | *Engliſh* L's. | *Guilders.* |
|---|---|---|---|---|---|
| | 6 | 1,775 | 10,65 | ,5633802 | ,0936967 |
| | 6 ½ | 1,77708ʒ | 10,6625 | ,5627198 | ,0937866 |
| | 7 | 1,7791℔ | 10,675 | ,5620608 | ,0936768 |
| | 7 ½ | 1,78125 | 10,6875 | ,5614035 | ,0935673 |
| | 8 | 1,78ʒ | 10,7 | ,5607477 | ,0934579 |
| | 8 ½ | 1,7854ı℔ | 10,7125 | ,5600933 | ,0933489 |
| | 9 | 1,7875 | 10,725 | ,55944ø5, &c. | ,0932401 |
| | 9 ½ | 1,7895ʒ | 10,7375 | ,5587893 | ,0931315 |
| | 10 | 1,791℔ | 10,75 | ,5581395 | ,0930233 |
| | 10 ½ | 1,79375 | 10,7625 | ,5574913 | ,0929152 |
| | 11 | 1,795ʒ | 10,775 | ,5568445 | ,0928074 |
| | 11 ½ | 1,7979℔ | 10,7875 | ,5561993 | ,0926999 |
| 36 | — | 1,8 | 10,8 | ,55, &c. | ,0925 |
| | 00 ½ | 1,80208ʒ | 10,8125 | ,5549133 | ,0924856 |
| | 1 | 1,8041℔ | 10,825 | ,5542725 | ,0923788 |
| | 1 ½ | 1,80625 | 10,8375 | ,5536332 | ,0922722 |
| | 2 | 1,808ʒ | 10,85 | ,5529954 | ,0921659 |
| | 2 ½ | 1,8104ı℔ | 10,8625 | ,5523590 | ,0920598 |
| | 3 | 1,8125 | 10,875 | ,5517241 | ,0919540 |
| | 3 ½ | 1,8145ʒ | 10,8875 | ,5510907 | ,0918484 |
| | 4 | 1,81℔ | 10,9 | ,5504587 | ,0917431 |
| | 4 ½ | 1,81875 | 10,9125 | ,5498281 | ,0916547 |
| | 5 | 1,8208ʒ | 10,925 | ,5491991 | ,0915665 |
| | 5 ½ | 1,8229ı℔ | 10,9375 | ,5485714 | ,0914286 |
| | 6 | 1,825 | 10,95 | ,5479452 | ,0913242 |
| | 6 ½ | 1,8270ʒ | 10,9625 | ,5473204 | ,0912201 |
| | 7 | 1,8291℔ | 10,975 | ,5466970 | ,0911162 |
| | 7 ½ | 1,83125 | 10,9875 | ,5460751 | ,0910125 |
| | 8 | 1,83ʒ | 11, | ,54 | ,0909, &c. |
| | 8 ½ | 1,8354ı℔ | 11,0125 | ,5448354 | ,0908059 |
| | 9 | 1,8375 | 11,025 | ,5442177 | ,0907029 |
| | 9 ½ | 1,8395ʒ | 11,0375 | ,5436014 | ,0906002 |
| | 10 | 1,841℔ | 11,05 | ,5429864 | ,0904977 |
| | 10 ½ | 1,84375 | 11,0625 | ,5423729 | ,0903955 |
| | 11 | 1,8458ʒ | 11,075 | ,5417607 | ,0902934 |
| | 11 ½ | 1,8479ı℔ | 11,0875 | ,54115 | ,0901916 |
| 37 | — | 1,85 | 11,1 | ,54ø5, &c. | ,0900, &c. |
| | 00 ½ | 1,8520ʒ | 11,1125 | ,5549133 | ,0924855 |
| | 1 | 1,854ı℔ | 11,125 | ,5542725 | ,0922121 |
| | 1 ½ | 1,85625 | 11,1375 | ,5536332 | ,0921722 |
| | 2 | 1,858ʒ | 11,15 | ,5529954 | ,0921659 |
| | 2 ½ | 1,8604ı℔ | 11,1625 | ,5523590 | ,0920598 |

| *s.* *d.* | *Flem.* L's. | *Guild.* | *Engliſh* L's. | *Guilders.* |
|---|---|---|---|---|
| 3 | 1,8625 | 11,175 | ,5517241 | ,0919540 |
| 3 ½ | 1,864583 | 11,1875 | ,5510907 | ,0918484 |
| 4 | 1,86 | 11,2 | ,5504587 | ,0917431 |
| 4 ½ | 1,86875 | 11,2125 | ,5498282 | ,0916380 |
| 5 | 1,8708 3 | 11,225 | ,5491991 | ,0915332 |
| 5 ½ | 1,872916 | 11,2375 | ,5485704 | ,0914284 |
| 6 | 1,875 | 11,25 | ,5479452 | ,0913242 |
| 6 ½ | 1,877083 | 11,2625 | ,5473204 | ,0912201 |
| 7 | 1,8791 6 | 11,275 | ,5466946 | ,0911158 |
| 7 ½ | 1,88125 | 11,2875 | ,5460751 | ,0910125 |
| 8 | 1,88 3 | 11,3 | ,54, &c. | 00, &c. |
| 8 ½ | 1,885416 | 11,3125 | ,5448354 | ,0908059 |
| 9 | 1,8875 | 11,325 | ,5442177 | ,0907029 |
| 9 ½ | 1,889583 | 11,3375 | ,5436014 | ,0906002 |
| 10 | 1,8916 | 11,35 | ,5429864 | ,0904977 |
| 10 ½ | 1,89375 | 11,3625 | ,5423740 | ,0903957 |
| 11 | 1,89583 | 11,375 | ,5417607 | ,0902934 |
| 11 ½ | 1,897916 | 11,3875 | ,5411499 | ,0901916 |
| 38 | 1,9 | 11,4 | ,540, &c. | ,09009009 |

### *The Uſe of the foregoing Table.*

This *Table* extends from 32 *Schillings* to 38 *Schillings Flemiſh*, for a L. *Sterling*, the extreme Limits whereof very rarely happen; but the common *Courſe* of *Exchange* between *England* and *Holland*, is from 34 *Schillings* to 36*s.* 6*d.* per L. *Sterling*, tho' there may be Occaſion upon ſome extraordinary Emergencies to uſe ſome of the other Rates: You are likewiſe to obſerve, that ¼ or ¾ of a *Penny*, are ſeldom or never us'd, and generally even *Pence*, tho' I have put ½ throughout the Whole.

### *EXAMPLE.*

*If I was to remit* L. 675 : 12 : 6 Sterling *from* London *to* Rotterdam, *Exchange at* 35 *s.* 9 *d.* ½ Flemiſh, *per* L. Sterling, *How many* Guilders, *&c. muſt I receive there?*

*Note*, Tho' the *Computation* or *Courſe* is expreſſed in *Schillings* and *Pence* for a L. *Sterling*, the *Bills* are always expreſſed in *Guilders* and *Stivers*, &c. Therefore I look for the *Courſe* in the firſt *Column*, and againſt 35 *s.* 9 *d.* ½ I find in the third *Column*, under the Word *Guilders*, the fix'd *Number* 10,7375, by which multiplying the given *Sum*

(having first turn'd the *odd Money* into *Decimals*) by the contracted *Method*, and it will ſtand thus:

675,625.
5737,01

67562 50
4729 38
20269
4729
338

7254,524

Or 7254 *Guilders* 10 *Stivers* and $\frac{1}{2}$.

As all *Monies* and *Bills* in the *Low-Countries* are negotiated in *Bank-Money*, that amount to more than 300 *Florins* or *Guilders*, and not in *common* or *current Monies*, ſuch as *Schillings*, &c. and as the *Bank-Money* is finer than the *current Money*, and as there muſt be *Books* of *Accompt* kept with the ſeveral *Parties*, ſo an *Agio* or Allowance for ſuch *Trouble* and *Intereſt*, is made from 3 to 6 per *Cent*. therefore it may not be amiſs to have an *Example* or two of reducing *Common* to *Bank-Money*, at 2 or 3 different *Agio's* or *Allowances*: For ſuppoſe I ſhould ſend a Parcel of *Goods* to *Amſterdam* or *Rotterdam*, &c. and ſhould chooſe to have a Remittance for the ſame in *Money*, and not in *Goods*; then my Correſpondent will charge me, over and above all Charges of *Weighing*, *Meaſuring*, *Warehouſe-Room*, *Commiſſion*, &c. the *Agio* at 3, 4, 5, &c. per *Cent*. As for Inſtance,

*Suppoſe I have* Goods *that amount to* 3865 Guilders, *or* Florins, current Money, *How much* Bank-Money *will that come to* Agio, *at* 5 per *Cent*?

Say, As $\frac{101}{21}$ current is to $\frac{100}{20}$ Bank; ſo is 3865 current to 3680 : 19 : $2\frac{1}{21}$ Bank.

3865

5 | 105 : 100
21 20

3865
20

21) 77300 (3860 : 19 $\frac{1}{21}$
63

143
126

170
168

20 Remains.
20 Stivers.

400
21

190
189

1

21 Remains.

Or you may do it thus:

(5)

If $\frac{105}{21}$ 100) 3865 Guilders.

773
100

Bank

21) 77300 (3680 $\frac{20}{21}$ or 19 Stivers $\frac{1}{21}$

Or thus:

If $\frac{105}{21}$ $\frac{100}{20}$ 21) 3865 Guilders.
184 $\frac{1}{21}$

3680 $\frac{20}{21}$ or 19 *Stiv.* $\frac{1}{21}$ Bank.

Again,

Current
*Flor. Stiv. Pen.*
In 2459 : 17 : 8 *Agio* at 4 $\frac{2}{16}$, How much Bank?

*Flor.* or *Guil. Stiv. Pen.*
If 104 $\frac{2}{16}$ — 100 — 2459 : 17 : 8 to 2352 : 10 : 13 *fer.*

16 16

633 14758
104 2460

1673 )3935800 (2352

904 *St. Pen.*
Remains, which is 10 : 13 *fere*
1673

Or thus:

*Guil. Dec.*
As 104,5625 is to 100, so is 2459,875 to 2352,540

But if you want to know only how much the *Agio* comes to, do thus:

As 100 is to 4 $\frac{2}{16}$ or 4,5625, so is 2459,875 to
52654

Or *Decimally* thus, by *Practice.*

| | | |
|---|---|---|
| at 1 *p. Cent.* | 24,59875 | 9839500 |
| | | 1229938 |
| at 4 *per Cent.* | 98,39500 | 147593 |
| at $\frac{2}{16}$ — | 12,299375 | 4920 |
| at $\frac{1}{16}$ — | 1,537422 | 1230 |
| | 112,231797 | 112,23181 |

Or,
112 : 4 : 11, *fere. &c.*

Or

Or thus in common Numbers.

| | *Flor.* | *Stiv.* | *Pen.* |
|---|---|---|---|
| 1 *per Cent.* | 2459 : | 17 : | 8 |
| | | | 4 |
| 4 *per Cent.* | 9839 : | 10 : | — |
| $\frac{3}{16}$ is $\frac{1}{8}$ of 4 | 1229 : | 18 : | 12 |
| $\frac{1}{16}$ is $\frac{1}{8}$ of $\frac{3}{16}$ | 153 : | 14 : | 13 $\frac{1}{2}$ |
| 112 | 23 : | 3 : | 9 $\frac{1}{2}$ |
| | 20 | | |
| 4 | 63 | | |
| | 16 | | |
| 10 | 27 | | |

And ſo for any other Rate whatever, by ſome of theſe Methods, you will have the Anſwer requir'd.

We now paſs on to give ſome Examples of other Coins and Countries, and firſt for *France*, that being the next neareſt to us.

## *FRANCE.*

Here they keep their *Accounts* in *Livres*, *Sols* and *Deniers*, but *exchange* by the *Crown*, which at *Par* is worth 4 *s.* 6 *d. Sterling*; ſo that 3 *Livers* 60 *Sols*, or *French-Pence*, is equal to 4*s.* 6*d.* or 54 *Pence* Sterling; 1 *Liver* or 20 *Sols*, French, is equal to 1 *s.* 6*d.* or 18 *Pence*, Sterling; 1 *Sol*, or 12 *Deniers*, French, is equal to 3 *F.* $\frac{1}{4}$ or $\frac{2}{10}$ of a *Penny* Sterling; 1 *Denier* French, is equal to $\frac{3}{10}$ of a *Farthing*, Sterling.

## *EXAMPLE* 1.

1. *Suppoſe I take up* 500 *Crowns, at* Lyons *in* France, *and draw a Bill upon my Correſpondent in* London *at* 52 *d.* $\frac{1}{2}$ *per Crown, How much* Sterling *Money muſt be paid for the ſame?* Anſ. L. 109 : 7 : 6.

You may work this, and ſuch like Queſtions, by any of the following Methods.

*Crowns*

*Crowns*
500 at 52 *d.* ½ *per* Crown.

500
26000
250
12 | 26250
2|0 | 218|7 : 6

L. *Sterl.* 109:7 : 6 Anſwer.

Or thus:

*Crowns.*
500 at 52 *d.* ½ or 4 *s.* 4 *d.* ½ *per* Crown.

| | | |
|---|---|---|
| 4 *s.* ⅓ L. | 100 | |
| 4 *d.* $\frac{1}{12}$ 4 *s.* | 8 : 6 : 8 | |
| ½ *d.* ⅛ 4 *d.* | 1 : – : 10 | |

L. 109 : 7 : 6 Anſwer, as before.

Or *Decimally* thus:

52 *d.* ½ or 4 *s.* 4 *d.* ½ is ,21875 *per* the Table, Page 205.
500 Crowns.

L. 109,37500

Or, L. 109,7 : 6 as above.

## *EXAMPLE 2.*

*Suppoſe I remit L.* 613 : 8 : 9 Sterling *to* Paris, Exchange *at* 56 *d.* ¼ Sterling *for a* French *Crown, How many Crowns muſt be receiv'd at* Paris? Anſ. 2594 *Crowns* 1 *Liver* 7 *Sols* 4 *Deniers.*

Here working by the Rule of *Three*, I ſay, *Cr. Sol. Den.* As 56 *d.* ¼ is to 1 *Crown*, ſo is L. 613 : 8 : 9 to 2594 : 16 : 4 $\frac{4}{17}$

Theſe Numbers reduc'd and work'd by any of the former Methods will come to 2594 *Crowns* 16 *Sols* 4 *Deniers*, and

and $\frac{144}{227}$ Parts of a *Denier*; but in Buſineſs they never take Notice of Parts of a *Denier*.

In *Italy* they keep their Accounts in the ſame *Species* with *France*, but the *Exchange* is by the *Dollar* or *Piece* of $\frac{8}{8}$, which is worth 4 *s.* 6*d. Sterling*; ſo that 'tis in all Reſpects the ſame as *France*, only the *Crown* is called a *Dollar* or Piece of $\frac{8}{8}$.

## *SPAIN.*

Here they keep their Accounts in *Rials* and *Mervadies*, but *exchange* with the *Piece* of *Eight*, whoſe *Par* is 4 : 6 *Sterling*; and 1 *Mervadie* is - - $\frac{1}{471}$ of a *Farthing* Sterling; 372 *Mervadies* is 1 *Rial*, which is 6*d.* $\frac{1}{4}$ Sterling; 8 *Rials* is 1 *Piece* of $\frac{8}{8}$, or 4*s.* 6*d.* Sterling.

## *EXAMPLES.*

1. *How many Pieces of* $\frac{8}{8}$ *muſt I receive for* L. 300 Sterling, *Exchange at* 53*d. per Pieces of* $\frac{8}{8}$?

$\frac{8}{8}$ *Ri. Mer.*

Anſwer, 1358 : 3 : 343 $\frac{42}{53}$.

Here ſay, by the Rule of *Three*, As 53*d.* is to $\frac{8}{8}$ ſo is L. 300. Then work as in common, and you'll find the Anſwer come out as above.

2. *Deliver'd at* Madrid 2000 *Pieces of* $\frac{8}{8}$, *Exchange at* 56 *d.* $\frac{1}{2}$, *What muſt be receiv'd in* London?

Anſwer, L. 470 : 16 : 8.

This Queſtion is done like the firſt, in *French Money*.

## *PORTUGAL.*

Here they keep their *Accounts* in the nominal *Species* called *Rees*, which are the Subdiviſion, and a *Thouſand* of theſe is the *Integer*; one thouſand *Rees* are about 6*s.* 9*d. Sterling* at *Par*, and is called a *Mill-Ree*. Upon the *Portugal* Coins called *Moidores*, double *Moidores* half *Moidores*, &c. is ſtamped 4000, 8000, 2000, *&c.* or 4 *Mill-Rees*, 8 *Mill-Rees*, &c. But on the 9's, 18's, 36's and L. 3 : 12 Pieces the *Rees* are not ſtamped.

## *EXAMPLE.*

*How many Mills and Rees muſt I have for* L. 250 Sterling, Exchange *at* 6 : 5 *per* Mill-Ree?

*Mills* *Rees.*
As 6,5 — 1,000 — L. 250 Anſ. 779 - 220 $\frac{60}{77}$
12 240

77 77 ) 60000,000 ( 779, 220 $\frac{60}{77}$
*Mills, Rees.*

*If I have a Bill for* 1758 *Mills* 340 *Rees, Exchange at* 5 *s.* 10 *d.* $\frac{1}{2}$ *Sterling, per* Mill-Ree, *How much* Sterling-Money *muſt be receiv'd for the ſame?*

This Example may be wrought after any of the following Methods.

*Mills Rees.* *s.* *d.*
1758,340 at 5 : 10 $\frac{1}{2}$ *per* M. R.

| | | |
|---|---|---|
| 5 *s.* $\frac{1}{4}$ L. | 439 : 10 | 1 : 2 : 0 : $\frac{1}{2}$ for 200 |
| 10 *d.* $\frac{1}{6}$ 5 *s.* | 73 : 5 | 7 : 0 : 1 — 100 |
| $\frac{1}{2}$ $\frac{1}{20}$ 10 *d.* | 3 : 13 : 3 | 1 : 1 : 3 + $\frac{1}{5}$ 20 |
| for 320 Rees | : 2 : — | 1 : 1 : 3 + $\frac{1}{5}$ 20 |
| | L. 516 : 10 : 3 Tot. | 1 : 11 : 3 : 4 + $\frac{2}{5}$ for 340 |

Here, after finding the Value of 1758 *Mills*, then I take the Parts of 1000 for the 340 *Rees*, which comes to 1 *s.* 11 *d.* 3 *f.* $\frac{22}{25}$, which wanting but $\frac{1}{25}$ of a *Farthing* of 2 *s.* I ſet down 2 *s.* for it, and then the whole comes to L. 516 : 10 : 3. Or you may find the Value of 340 *Rees* by ſaying, As 1000 is to 5 : 10 $\frac{1}{2}$, ſo is 340 to 2 *s.* almoſt: Or you may do the Whole *Decimally* thus:

1758,340
573920
351 668
158 251
5 275
1 231
88
516,513
Or
L. 516: 10: 3

Or thus:
1758,340
Pence *St.* in a *Mill* 70 $\frac{1}{2}$
123083 | 800
879 | 170
12 | 123962 | $\frac{270}{1000}$ Ps of a *Pen.*
2|0|1033| 0—2
L. 516|10—3

*Note*, The firſt Line ariſes by multiplying by 70, and the ſecond Line by dividing by 2, or taking the $\frac{1}{2}$ of the given Line

Line, and three Figures parted off upon account of 1000 being the *Denominator* of the *Mill Ree*; then the *Product* 123962 is *whole Pence*, and the 970 are so many 1000 Parts of a *Penny*, which wanting but $\frac{1}{100}$ of the whole, I set down a Penny for it, which is added to L. 516 : 10 : 2, the Amount of 123962 *Pence*; and the Whole is L. 516 : 10 : 3, as before.

As *Portugal* and *England* have now, and in all probability, will long have a considerable Trade together, and in Consequence thereof, much Negotiation of Bills between them, I will give another Example, wrought by all the foregoing Methods, to make them more evident.

Mills Rees.

*What Sum* Sterling *must be receiv'd in* London *for* 2756,675 *Exchange at* 6 *s.* 2 *d.* $\frac{1}{4}$ Sterling *per* Mill Ree?

Answer, L. 858 : 19 : 9½.

(1)

2756 *Mills* and 675 *Rees* at 6 *s.* 2 *d.* ¼ per *M. R.*

| | | | | |
|---|---|---|---|---|
| 4 *s.* ½ L. | 551 : 4 | 250 is ¼ of 1000 | 1 : 6 : 2 : ¾ | |
| 2 *s.* ½ 4 *s.* | 275 : 12 | 125 is ½ - 250 | - : 9 : 1 : 1½ | |
| 2 *d.* ½ 2 *s.* | 22 : 19 : 4 | 200 is ⅘ 1000 | 1 : 2 : 3 : 3 - : ⅖ | |
| ½ ¼ 2 *d.* | 5 : 14 : 10 | 100 is ½ 200 | - : 7 : 1 : 3 1 : 1 | |
| ¼ ½ ½ *d.* | 2 : 17 : 5 | | | |
| 675 *Rees* is | - : 4 : 2½ | 675 is | - 4 : 2 : 1 : 3 - : 3 | |

L. 858 : 11 : 9½

(2)

*Decimally* thus:

,3114583
576,6572

622917
218021
15572
1868
187
22
2

858,589

Or, L. 858 : 11 : 9½

(3)

Or thus:

2756,675

Pence in a *Mill-Ree* 74 ¼

11026700
19296725 :
1378337 ½
689168 ¼

12 | 206061,456 ¼

2|0|17171,9

L. 858 : 11 : 9 ½

(1)

To find the Value of the Fractions in the first Method, observe the Directions given in Page 154; and in the third Method, you are to observe, that the 456 ¼ Parts of a Penny are found by multiplying them by 4, and cutting off 3 Figures from the Product, and then 'twill be 1,825 which is 1 Farthing, and 825 thousand Parts of a Farthing, which reduc'd will come to $\frac{11}{40}$ of a Farthing, the same with the first Method; but as it is near, we put down a Half-penny for it, which exactly agrees with the *Decimal* Method, computed by the common Rule; from whence may be observ'd, how easy the *Decimal* or second Way is, above either the 1 or 3, which requires so many different Operations.

Now we will only touch upon the *Exchange* between *London* and *Dublin*, &c. where, tho' the same Species of Money is current, and the Methods of keeping Accounts are the same, yet the Value of Money, in the two Places, is very different at different Times; therefore you shall have an Example or two.

## *IRELAND.*

*If I remit* L. 250 Sterling, *from* London *to* Dublin, *Exchange at* 8 ¼ *per* Cent. *more to be receiv'd in* Dublin, *What is the Sum to be paid at* Dublin?

Ans. L. 270 : 12 : 6 *Irish.*

L. 250

L. 250 at 8 ¼ *per* Cent.

| | | |
|---|---|---|
| 4 1/25 of 100 | 10 — | |
| 4 1/25 ditto | 10 — | |
| 1/4 1/16 of 4 | 0 : 12 : 6 | |
| | 270 : 12 : 6 | |

Or thus:

L. 250 at 8 ¼

| | |
|---|---|
| 5 1/20 of 100 | 12,5 |
| 2 1/2 1/5 5 | 6.25 |
| 1/2 1/5 2 1/2 | 1.25 |
| 1/4 1/2 1/2 | —625 |
| | L. 270.625 |

Or thus *Decimally*.

*St.* *Irish*

As *L.* 100 is to 108.25 — 250 *Sterl.* to L. 270 : 12 : 6

250

541250

21650

270,6250

Or

L. 270 : 12 : 6

This latter *Method* may be full as well or better than the upper one, when the Sums have odd *Money*, upon account of the Easiness of the Divisors; as,

*Suppose* L. 618 : 13 : 8 *to be remitted to* Dublin *from* London, *at* 8 ¼ *per* Cent.

You may do thus:

| | |
|---|---|
| 100 is | L. 618 : 13 : 8 at 8 ¼ |
| 4 1/25 of 100 | 24 : 14 : 11 2/9 |
| 4 ditto | 24 : 14 : 11 9 |
| 1/4 1/16 25 | 1 : 10 : 11 5 + 1/4 |
| 108 ¼ is | L. 669 : 14 : 5 21/100. |

Or thus:

| | | | | |
|---|---|---|---|---|
| 100 is | L. 618 | 13 | 8 | |
| 5 is $\frac{1}{20}$ | 30 | 18 | 8 | $\frac{120}{20}$ |
| 2 $\frac{1}{2}$ - $\frac{1}{2}$ | 15 | 9 | 4 | 10 |
| $\frac{1}{2}$ $\frac{1}{4}$ | 3 | 1 | 10 | 42 |
| $\frac{1}{4}$ $\frac{1}{2}$ | 1 | 10 | 11 | 21 |
| 108 $\frac{1}{4}$ is | L. 669 | 14 | 5 | 93 |

Which in Buſineſs may be called 6*d.* for it is 3 Farthings and $\frac{22}{100}$ Parts of a Farthing.

*Decimally* thus:

108,25
618,683

9 | 324750

3608*z* for the *z*
86600
64950
86600
10825
64950

669,7247083

Or, L. 669 : 14 : 6 almoſt.

Or thus:

618,683
108,25

3093416
12373666
494946666
6186833333

669,7247083

These two Products are exactly the ſame; and if the Value of the *Decimal* be found, according to the Rule, Page 176, 'twill come to 14 : 5 : 9, and $\frac{21}{100}$, as above.

The like is to be obſerv'd in all other Rates whatever, only that the Parts of ſome Rates, are more troubleſome than the Parts of other Rates, to work by *Practice*; and therefore, how fond ſoever ſome People may be of that Rule, 'tis frequently in a Manner impracticable, as in this Example following.

If

*If I remit* L. 795 Iriſh, *from* Dublin, *to receive the Value in* London, *Exchange at* 7 ½ *per* Cent. *How much* Sterling *Money muſt I receive?*

Anſwer, L. 739 : 10 : 8 ¼.

*Sterl.*

If 107,5 give 100 795. (739,534

7525

Or 4250

3225

L. 739 : 10 : 8 ¼ 10250

9675

5750

5375

3750

3225

5250

4300

9500

8600

900, &c.

Or thus:

L. 107 ½ — 100 — 795

2 2

215 215)159000(739 : 10 : 8 ¼

1505

850

645

2050

1935

115 Parts of a L.

115 Parts of L.

115 Parts of a L.
20

215) 2300 ( 10 Shillings.
215

150 Parts of a Shilling.
12

215) 1800 ( 8 Pence.
1720

80 Parts of a Penny.
4

215) 320 ( 1 Farthing.
215

105 or
215 $\frac{1}{43}$ of a Farthing.

By *Practice* thus:

| L. 107 $\frac{1}{2}$ is — — L. 795 | | 43 |
|---|---|---|
| 2 $\frac{1}{2}$ is $\frac{1}{43}$ of 107 $\frac{1}{2}$ | 18 : 09 : 09 : 0 : 36 | |
| 5 is 2 times 2 $\frac{1}{2}$, which is | 36 : 19 : 06 : 1 : 29 | |
| 7 $\frac{1}{2}$, this Total ſub. L. | 55 : 09 : 03 : 2 : 22 | |
| 100 is the Remainder L. | 739 : 10 : 08 : 1 : 21 | |

for the *Sterling Money*, as above.

But there are ſome Rates from *Dublin* to *London*, that the *Aliquot Parts* cannot be taken at all; and in ſuch Caſes *Practice* cannot be made uſe of. As, Suppoſe at 7 $\frac{1}{4}$, 8 $\frac{1}{2}$, 9 $\frac{1}{4}$, *&c.* but let the Rate be what it will from *London* to *Dublin*, you may always do it by *Practice*, as appears by the firſt Example of this *Exchange*.

I ſhall not continue any longer upon the Subject of ſingle *Exchanges*, but only take notice that the *Weights* and *Meaſures* of different *Countries*, vary as much as their *Coins*, and that thoſe who are expert in working the foregoing *Examples*, will eaſily apply the former Methods thereto. The next Thing

Thing we ſhall touch on, is what is commonly called the *Arbitration* of *Exchanges*, that is, adjuſting ſeveral *Rates* or *Courſes* of *Exchanges* and *Coins* of different *Countries*, and reducing them ſo, as if the *Exchange* was made directly to, or from ſome one Place to another; by which the *Profit* or *Loſs* of negotiating *Bills* of *Exchange* will appear. As for Example,

*Suppoſe I remit from* London *L.* 300 Sterling *to my Correſpondent at* Amſterdam, *at the Rate of* 18 *d.* Sterling *for a* Guilder Flemiſh, *with Orders for him to remit the Nett Proceed to* Bourdeaux *in* France, *after deducting his Commiſſion of* ½ *per* Cent. *for his Trouble, &c. at the Rate of* 3 Guilders *per* French Crown, *How many Crowns muſt be receiv'd at* Bourdeaux? Anſwer, 1326 *Crowns* and 40 *Sols.*

*L.* 300 *Sterling.*
40

6 *Pences* in a *Guild.* 3 | 12000 *Sixpences.*

If 100 - ½ - 4000 *Guilders.*
20 ditto for Commiſſion.

*Guild.* in a *Crown* 3 | 3980 dit. to be remit. to *Bourdeaux*

1326 : 40 to be paid in *Bourdeaux.*
Crowns and Sols.

Or, Suppoſe the Sum in the foregoing *Queſtion* was, *L.* 376, and the Commiſſion but ¼ *per* Cent. then you may work as follows.

*L.* 376
40

3 | 15040

| | *Guil.* | *Stiv.* | *Pen.* |
|---|---|---|---|
| | 100 - ¼ | or 6 : 10 | ½ |
| | 10 ⅒ of 100 - | : 10 : | 2 |
| | 2 ½ | : 2 : | ½ |
| | 1 ½ | : 1 : | 1 |

*Stiv. Pens.*

If 100 - ¼ 50,13 : 6 : 10 : ½ 6 : 2 *Pen.* is ½ : 0 : 1 2

16 : 13 : 5 : 1
14 : 0

16 : 14 : 5 : 1 Commiſſion.

3 *Guild.* is a *Cr.* 3|4996 : 12 : 7 : 0 *Guild.* &c. to be exchanged.

|1665 : 32 ½ Anſ. *Crowns* to be receiv'd at *Bour.*

Here

Here the Commiſſion for the odd Parts, *viz.* 13 *Guilders* 6 *Stivers*, 10 *Pennings* is ſomewhat more than 14 *Pennings*; but in aſmuch as the Amount is inſignificant above 14 *Pennings*, omit it, and adding the Amount of the Parts to the Amount of the 50 Hundreds, the Total is 16 *Guilders*, 14 *Stivers*, 3 *Pennings* $\frac{1}{3}$, *&c.* which ſubſtracting from the Whole, leaves 4996 : 12 : 7 to be exchang'd, which produces 1665 *Crowns*, 32 *Sols* $\frac{7}{16}$, for which I put down $\frac{1}{2}$, it wanting ſo ſmall a Matter.

Now if to the above Queſtion, was added the following Clauſes. *How much is gain'd or loſt in all, and* per Cent: *by the above Circulation? And what is the direct Exchange between* London *and* Bourdeaux?

In the firſt *Queſtion* the *Loſs* in all is L. 1 : 10 which is $\frac{1}{2}$ *per* Cent. and the direct Exchange from *London* to *Bourdeaux* is at 54 *d.* $\frac{1}{4}$ $\frac{17}{199}$ *Sterling* for a *French-Crown*, which is 1 *Farthing* $\frac{17}{199}$ above *Par*, or *Loſs* by every *Crown*, as may be eaſily tried by ſaying: As,

1 Crown is to 1 *Far.* $\frac{17}{199}$; ſo is 1326 $\frac{2}{3}$ to L. 1 : 10.

In the ſecond *Example* the *Loſs* in all is L. 1 : 5 : - $\frac{1}{4}$, which is L. $\frac{1}{3}$ *per* Cent. and the direct *Exchange* is 54 $\frac{7211}{39973}$ *Sterling* per *French* Crown. The like Methods are to be obſerved, let the Places or Rates be where, or what they will.

*Suppoſe a Bill for* L. 500 Sterling, *negotiated as follows*, viz. *firſt from* London *to* Amſterdam *at* 38 *s.* Flemiſh *for a L.* Sterling, *then from* Amſterdam *to* Frankford *at* 6 *s.* Flem. *for* 66 Cruitzers; *and from* Frankford *to* Paris *at* 54 Cruitzers *for a* French Crown, *How many* French Crowns *muſt be paid for the laſt Negotiation, and what is the direct Exchange between* Paris *and* London?

Anſwer, 3870 *French* Crowns 22 *Sols* $\frac{2}{9}$ for the *Whole*, at the Rate of 31 *d.* $\frac{1}{269}$ *Sterling* for a *French* Crown, directly between *London* and *Paris*. Found thus by the *Rule* of *Three*,

As L. 1 *Sterling* is to 38 *s. Flemiſh*, ſo is L. 500 *Sterling* to L. 950 *Flemiſh*.

Then,

As 6 *s. Flemiſh* is to 66 *Cruitzers*, ſo is L. 950 *Flemiſh*, to 209000 *Cruitzers*.

And,

As 54 *Cruitzers* is to 1 *French* Crown, ſo is 209000 *Cruit.* to 3870 Crowns $\frac{10}{27}$, or 3870 Crowns 22 Sols $\frac{2}{9}$.

Then,

As 3870 Cr. $\frac{10}{27}$ is to L. 500 *St.* ſo is $\frac{27}{27}$ to 31 *d.* $\frac{1}{269}$ *Ster.*

Or you may do this, and all ſuch like Queſtions, more eaſily thus:

*Set down the ſeveral Proportions given, and multiply thoſe that ſtand one over another continually together, making the Product on the Left-hand the Diviſor, and the Product on the Right-hand the Dividend, and the Quotient will be your Anſwer.*

L. 1 *Sterling* is equal to 38 *s. Flemiſh.*
6 *s. Flemiſh* is equal to 66 *Cruitzers.*
54 *Cruitzes* is equal to 1 *French Crown.*

324 Diviſor - - - 2508 Divid. ($7\frac{20}{27}$ Quotient, which is 7 *French Crowns* and $\frac{20}{27}$ for a Pound *Sterling*, which multiply'd by L. 500 gives 3870 $\frac{20}{27}$, and by ſaying,
If 7 *Crowns* $\frac{20}{27}$ be 1 L. *Sterling*, What is 1 *Crown?*
The Anſwer will be 31 *d.* $\frac{1}{200}$, as above.

By the ſame Method may Weights and Meaſures be adjuſted. As,

*Suppoſe* 35 *Ells of* Vienna *make* 24 *Aulns of* Lyons, *and* 3 *Aulns of* Lyons 5 *Ells of* Antwerp; *and* 4 *Ells of* Antwerp 5 *Ells of* Frankford: *How many Ells of* Vienna *are equal to* 700 *Ells at* Frankford?

Anſwer, 490 Ells at *Vienna.*

Here, following the Directions laſt given, I ſay,
35 at *Vienna* is equal to 24 at *Lyons*, and
3 at *Lyons* is equal to 5 at *Antwerp*, and
4 at *Antwerp* is equal to 5 at *Frankford.*

420 Diviſor 600 Dividend.

Ell $1\frac{1}{7}$ Quotient, that is $1\frac{1}{7}$ at *Frankford*, is equal to 1 Ell at *Vienna.*

Then,
As 10 is to 7, ſo is 700 to 490.

*Suppoſe* A *of* Amſterdam *ſhould order* B, *his Factor or Correſpondent at* Paris, *to remit* 4000 *Crowns to* London, *Exchange at* 49 *d.* $\frac{1}{4}$ Sterling *for a Crown; and for the Amount thereof to draw upon himſelf at* Amſterdam *at* 99 *Deniers* $\frac{1}{2}$ *per* Crown; *but it ſo happens that* B *remits to* London *at* 50 *d.* $\frac{1}{2}$ Sterling *per* Crown: *How muſt he draw upon* Amſterdam *to comply with his Orders, ſo that his Principal may neither gain nor loſe by this Variation in the* London *Courſe?*

Anſwer, At 101 *Deniers* per *Crown*, for if you ſay,

As 49 *d.* ¼ *St.* is to 50 *d.* ½ *St.* ſo is 99 *Den.* ½ *French* to 101 *Deniers French.*

For as he had limited the *Courſe* of the *Exchange* upon *London*, at 49 *d.* ¼, and receiv'd 50 *d.* ½ therefore he muſt pay proportionally more at *Paris* for the *Crown.*

More Queſtions may be given, but the ſame Laws of Proportion are to be obſerv'd, and ſome of the foregoing Methods will ſolve all the Occurrences of Buſineſs that can happen; ſo that we'll deſiſt ſaying any more upon this Subject, and go on to what is called *Alligation*; for tho' there is indeed a ſtrong Objection againſt the common numeral Way of performing the Calculations, upon Account of the ſmall Number of Anſwers that are ordinarily produced in whole Numbers, whereas by an *Algebraick* Proceſs, the ſame Queſtions might be ſo managed, as frequently to give a Variety of Anſwers in whole Numbers, limited to the particular Quantities in the Queſtion, and by properly increaſing or decreaſing the given Quantities, an innumerable Number of Anſwers in whole Numbers may be given; but as this Rule is applicable to many particular Buſineſſes, where Mathematical Exactneſs is not required, I will give ſome *Examples* of it in the common Way, and make proper Obſervations thereon; ſo that any indifferent Perſon may ſee the Uſefulneſs of that Part of *common Arithmetick*, call'd

## *ALLIGATION,*

From the binding or mixing ſeveral *Commodities* of different *Fineneſs*, *Rates*, *Values* or *Prices* together in one *Maſs*, *Quantity* or *Heap*, and to diſcover the particular *Quantities* or *Values*, &c. of each, that is neceſſary or required to make up the *Whole* of any particular *Fineneſs*, *Rate* or *Value*: And this is ordinarily divided into two *Species*, viz. firſt,

### *Alligation MEDIAL,*

Which is when the *Rates* and *Quantities* of ſeveral Sorts of the ſame *Species* of *Goods* are given, to know what the *Mean* or *Common Price*, *Value*, or *Fineneſs*, &c. is, of the *whole Maſs*, or *Quantity*, taken together; as in the following

### *EXAMPLE.*

*Suppoſe* 25 *Buſhels of Wheat at* 4 *s.* 8 *d. per Buſhel were mix'd with* 47 *Buſhels, worth* 3 *s.* 9 *d. per Buſhel, How much is a Buſhel of this Mixture worth?*

Anſwer, 4 *s.* 0 *d.* 3 *Far.* $\frac{5}{18}$.

'Tis very plain, that the ſeparate *Values* of the two Sorts of *Grain* here mentioned, muſt be firſt found by *Practice*, or otherwiſe.

As thus:

| | |
|---|---|
| *s.* *d.* | |
| At 4 : 8 *per* Buſhel | At 3 : 9 *per* Buſhel. |
| 5 | 4 |
| 1 : 3 : 4 Value of 5 Buſh. | 15 : — Value of 4 Buſhels. |
| 5 | 12 |
| L. 5 : 16 8 Val. of 25 dit. | L. 9 : 0 : — the Value of 48 dit. |
| L. 8 : 16 3 V. of 47 dit. | 3 : 9 Subſtract. for 1 dit. |
| | L. 8 : 16 : 3 remains for 47 |
| L. 14 : 12 11 V. of 72 mix'd | |

together.

And then ſay,

If 72 Buſhels are worth L. 14 : 12 : 11, What's 1 Buſhel?

20

*s.* *d.* *f.*

72)292 | 4 — : 3 $\frac{5}{18}$

288

4

12

59

4

236

216

20 5

— or — Remains.

72 18

Now if you would increaſe, or diminiſh your *Total Quantities*, and ſtill preſerve the ſame *Value*, you may do it by ſaying,

As 72 the *Total* now found, is firſt to 25, and then to 47, its two component Parts; ſo is the new *Total* given to its proportional *Quantities*: As, ſuppoſe I would enlarge the laſt *Total* to 100 *Buſhels*, I ſay, As

*Buſh.*

72 is to 25 ſo is 100 to $34\frac{22}{72}$, and as 72 is to 47 ſo 100 to $65\frac{40}{72}$

| | | | | | |
|---|---|---|---|---|---|
| | 100 | | | 100 | |
| 72 | 2500 (34 | | 72 | 4700 (65 $\frac{40}{72}$ | |
| | 216 | | | 432 | |
| | 340 | | | 380 | |
| | 288 | | | 360 | |
| | 52 | | | 20 | *Peck Pint.* |
| Rem. | —— Parts of a Buſhel. | | Rem. | —— or 1 : $1\frac{4}{9}$ | |
| | 72 | | | 72 | |

which is 2 Pecks 14 Pints and $\frac{2}{9}$.

*Buſhel*

Anſwer, $34\frac{22}{72}$ at 4 : 8 *per* Buſhel.
$65\frac{40}{72}$ at 3 : 9 ditto

100 Total at 4 *s.* 0 *d.* 3 *f.* $\frac{5}{18}$ *per* Buſhel.

But ſuppoſe you would make a *Mixture* as follows, of 3 Sorts of *Wines*, *Brandies*, &c. without abſolutely determining the *Total Quantity*, viz.

$\frac{1}{2}$ worth 4 *s.* a *Gallon*, $\frac{1}{3}$ at 5 *s.* a *Gallon*, and $\frac{1}{4}$ at 5 *s.* 6 *d.* *per* Gallon.

In ſuch like Caſes bring your given *Fractions* into a common *Denominator*, and the reſpective *Numerators* will be the *Quantities* that will anſwer the Conditions required: Which may be increaſed to any larger *Quantities*, by multiplying the ſeveral *Numerators* by ſome common *Number* greater than *Unity*, or made leſs by dividing the ſaid *Numerators* by ſome common *Number* greater than *Unity*.

Thus:

$\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$ may be $\frac{12}{24}$, $\frac{8}{24}$, $\frac{6}{24}$ or $\frac{24}{48}$, $\frac{16}{48}$, $\frac{12}{48}$, or $\frac{6}{12}$, $\frac{4}{12}$, $\frac{3}{12}$, &c. And when you have determined what your particular

*Quantities*

*Quantities* ſhall be, you muſt work as in the firſt *Example*. As, ſuppoſe I choſe to

mix 24 *Gallons* at 4 *s.* which is L. 4 : 16 : — with
16 Ditto - at 5 *s.* which is L. 4 : — : — and
12 Ditto at 5 *s.* 6 *d.* which is L. 3 : 6 : —

52 dit. is the *Tot.* Quant. and L. 12 : 2 : is the *Tot.* Val.

So that 1 *Gallon* of this *Mixture* is worth 4 *s.* 7 *d.* 3 *f.* $\frac{5}{13}$

Or if I choſe only to mix

6 *Gallons* at 4 *s.* which is L. 1 : 4 : — with
4 Ditto at 5 *s.* which is L. 1 : - : — and
3 Ditto at 5 *s.* which is L. - : 16 : 6

13 ditt. is the *Tot.* Quant. and L. 3 : — : 6 the *Tot.* Val.

And 1 *Gallon* of this *Mixture* will be worth 4 *s.* 7 *d.* 3 *f.* $\frac{5}{13}$ the ſame as above; and ſo of all other Quantities or Species that are in the ſame Ratio or Proportion of Goodneſs with the Example here given; and a like Procedure will anſwer any other whatever.

Again,

*Suppoſe the ſame proportional Numbers,* $\frac{1}{2}$, $\frac{1}{3}$, *and* $\frac{1}{4}$, *as above, and I have* 73 *Gallons of that worth* 5 *s.* viz. *that which muſt be* $\frac{1}{3}$ *of the whole Compoſition, How much muſt I mix of the other two to perform my Deſire?*

Anſwer, 109 *Gallons* $\frac{1}{2}$ at 4 *s.* and 54 *Gallons* $\frac{3}{4}$, at 5 *s.* 6 *d. per* Gallon.

Here I conſider 73 *Gallons*, the *Quantity* given, to be the *Numerator*; and as it repreſents $\frac{1}{3}$ I *multiply* it by 3, and the *Product* 219 is the common *Denominator*. Now $\frac{1}{2}$ of this is 109 *Gallons* and $\frac{1}{2}$, which is the *Quantity* of that at 4 *s.* per *Gallon*, and the $\frac{1}{4}$ is 54 *Gallons* $\frac{3}{4}$, which is the *Quantity* at 5 *s.* 6 *d. per* Gallon, as will appear by what follows,

For 73 *Gall.* at 5 *s.* per *Gallon*, is L. 18 : 5 : —
109 $\frac{1}{2}$ ditto at 4 *s.* ditto - - is L. 21 : 18 : —
54 $\frac{3}{4}$ ditto at 5 *s.* 6 *d.* ditto - is L. 15 : 01 : 1 $\frac{1}{2}$

*Tot.* Q. is 237 $\frac{1}{4}$ whoſe *Value* - - is L. 55 : 4 : 1 $\frac{1}{2}$

And a Gallon of this Mixture is worth 4 *s.* 7 *d.* 3 *f.* $\frac{5}{13}$, as before.

So

So if the Names of the *Species* and *Quantities* of the Goods were changed, but ſtill bore the ſame Proportion to one another, the Anſwer would be ſtill the ſame. As for Inſtance,

Suppoſe that I mix'd 73 *Oz.* of *Silver*, worth 5 *s.* an *Ounce*, with 109 *Oz.* $\frac{1}{2}$ of a coarſer Sort, worth but 4 *s.* an *Ounce*, and thoſe two with 54 *Oz.* $\frac{1}{4}$ of a finer Sort, worth 5 *s.* 6 *d.* an *Ounce*, this whole Mixture would be worth 4 *s.* 7 *d.* 3 *f.* $1\frac{1}{17}$ an *Ounce*; and ſo if they were Cloths of different Fineneſſes, *&c.* they would be worth the ſame per *Yard*, *Ell*, &c. or the like in any other *Commodity* whatever.

Again,

*Suppoſe I have* 8 lb's *of Silver of* 7 *Ounces fine*, 26 *Pounds of* 8 *Oz.* $\frac{1}{2}$ *fine, and* 17 lb's *of* 11 *Oz.* $\frac{1}{4}$ *fine, What is the Fineneſs of this whole Quantity melted together per* lb ?

Anſ. 9 *Oz.* 3 *Dwts.* 15 *Gr.* $\frac{1}{17}$.

| 8 | 26 | *per* 17 |
|---|---|---|
| 7 | 8 $\frac{1}{2}$ | 11 $\frac{1}{4}$ |
| 56 *Oz.* of fine Sil. —— in 8 lb's at *Oz.* fine. | 208 7 13 | 187 4 $\frac{1}{4}$ |
| | 221 *Oz.* of fine Silver —— in 26 lb's at 8 *Oz.* $\frac{1}{2}$ fine. | 191 *Oz.* of fine Sil. in 17 lb. at 11 $\frac{1}{4}$ fine. |

8 lb. yields 56 *Oz.* of *fine Silver.*
26 Ditto 221 Ditto
17 Ditto 191 $\frac{1}{4}$ Ditto

Total 51 lb's is 468 $\frac{1}{4}$

lb. *Oz. Dwts. Gr.*

As 51 lb's is to 468 $\frac{1}{4}$ ſo is 1 to 9 : 3 : 15 $\frac{1}{17}$ of *fine Silver*; ſo that, the remaining 2 *Oz.* 16 *Dwts.* 8 *Gra.* $\frac{16}{17}$ in every *Pound* Weight of Work made of this Mixture, muſt be of *Braſs*, *Copper*, *Tin*, *Pewter*, &c. as beſt ſuits with the Work that is to be ſo made. Now the *Standard* for the *Engliſh-Coin* is 11 *Oz.* 2 *Dwts. fine*; and of this Fineneſs generally is made the large *Silver Works*, ſuch as *Tankards*, *Salvers*, *Porringers*, &c. but the *Toys*, ſuch as ſmall *Tea-Spoons*, *Buckles*, *Thimbles*, &c. are generally made of a baſer Sort of *Metal*, or that which has more Alloy in it, ſuch as ſome of the above, *&c.* but if to the above, either a Quantity

tity of *pure Silver*, or a Quantity of abſolute *Alloy* were to be added, then the Total would be of a different *Fineneſs* or *Goodneſs* to that above, according as the Proportion of the ſaid Mixtures ſhould be more or leſs. As for Inſtance,

*Suppoſe to the above Quantities, I would add* 10 *Pounds of Silver, that was* 11 *Oz.* 16 *Dwts. fine, then the whole Maſs would be* 9 *Oz.* 12 *Dwts.* 2 *Gra.* $\frac{32}{61}$ *fine per* lb. *But if I would add* 10 *Pounds of* Alloy, *or* Copper, *&c. more to it, then it would be but* 7 *Oz.* 13 *Dwts.* 12 *Gra.* $\frac{8}{61}$ *per* lb. *fine.*

The ſecond Part of this Rule, commonly called *Alligation Alternate*, teaches you to mix ſeveral Sorts or Prices of Commodities together, ſo as to make the Quantity or Price what you pleaſe; and this is indeed properly *Alligation.*

## *ALIGATION ALTERNATE.*

### *EXAMPLES.*

*Suppoſe a Wine-Merchant would make a Mixture of ſeveral Sorts of white Wines,* viz. *ſome of* 7 *s.* 6 *d. ſome of* 6*s.* 9*d. ſome of* 5 *s. and ſome of* 4 *s.* 3 *d. per Gallon, and would take ſuch Quantities of each, that the Mixture may be worth* 5 *s.* 10*d. per Gallon, How much of each Sort will do the Matter?*

In working all ſuch like *Queſtions* as theſe, 'twill be proper to reduce the given *Rates* or *Prices* to the loweſt *Name* mentioned; and then ſet them down one under another, with the *mean Rate* againſt them; this done, for Convenience ſake, 'twill be proper to *tie* or *alligate* one or more together, and you muſt mind always to put a *bigger* than the *Mean-rate*, to a *leſſer* than the *Mean-rate*, and make *Subſtraction* either with, or from the *Mean-rate*, as the *Term* concerned is bigger or leſſer than it; and ſet down the *Reſult* or *Remainder*, not againſt the *Sum* the *Subſtraction* was made with, or from, but againſt that to which it is *tied* or *alligated.*

Thus:

| *d.* | | *Difference.* |
|---|---|---|
| *d.* 70 | 90 | 10 |
| | 81 | 19 |
| | 60 | 20 |
| | 51 | 11 |
| | | 60 |

Or thus:

| | | *Difference.* |
|---|---|---|
| 70 | 90 | 19 |
| | 81 | 10 |
| | 60 | 11 |
| | 51 | 20 |
| | | 60 |

Then add up the ſeveral *Differences* found, as above, and the *Total* will be a whole *Quantity* ſo mix'd, that may be ſold

ſold at the *Mean-rate*; and the particular *Sums* will be the *Quantities* of the ſeveral *Rates*. As in this *Queſtion* before us, in the firſt *Method* of *alligating*, the *Anſwer* is 10 *Gallons*, at 7 *s.* 6 *d.* 19 at 6 *s.* 9 *d.* 20 at 5 *s.* and 11 at 4 *s.* 3 *d.* per *Gallon*. By the ſecond Way of *alligating* there muſt be 19 *Gallons* at 7 *s.* 6 *d.* 10 at 6 *s.* 9 *d.* 11 at 5 *s.* and 20 at 4 *s.* 3 *d.* per *Gallon*, as may eaſily be try'd.

| *Gallons* | | | Thus: | | | | | |
|---|---|---|---|---|---|---|---|---|
| 10 at | 7 *s.* | 6 *d.* | is | L. | 3 | : 15 | : — |
| 19 at | 6 | 9 *d.* | is | L. | 6 | : 8 | : 3 |
| 20 at | 5 | - | is | L. | 5 | : - | : — |
| 11 at | 4 | 3 | is | L. | 2 | : 06 | : 9 |
| 60 at | 5 : 10 | | is | L. | 17 | : 10 | : — |

*So in the ſecond Method.*

| *Gallons.* | | | | | | |
|---|---|---|---|---|---|---|
| 19 at | 7 *s.* 6 *d.* | per *Gallon* is | L. | 7 | : 2 | : 6 |
| 10 at | 6 : 9 | ditto - - - | | 3 | : 7 | : 6 |
| 11 at | 5 : - | ditto - - - | | 2 | : 15 | : - |
| 20 at | 4 : 3 | ditto - - - | | 4 | : 5 | : - |
| 60 at | 5 : 10 | per *Gallon* is | L. | 17 | : 10 | : - |

*N. B.* You may *tie* or *alligate* any given *Quantities* or *Prices* as you pleaſe, provided you join a *leſs*, and a *bigger* than the *Mean-rate* together.

But if the *Total* produced by any of the foregoing *Methods*, are either too *much* or too *little*, you may ſay by the *Rule of Three*, As the *Totals* found as above, is to the *Quantity* wanted; ſo are the particular *Quantities*, above found, to the particular *Quantities* wanted. As, ſuppoſe I would fill a *Veſſel* of 40 Gallons or 100 Gallons, or any other different *Quantity* whatever, with the above *Mixture*, I muſt ſay,

| *Gall.* | *Gall.* | *Gall.* | *Gall.* | *s.* | *d.* |
|---|---|---|---|---|---|
| As 60 | is to 40 | ſo is 10 | to 6 : $\frac{4}{7}$ | at 7 | : 6 |
| 60 | — 40 | - - 19 | to 12 : 4 | at 6 | : 9 |
| 60 | — 40 | - - 20 | to 13 : 2 | at 5 | : - |
| 60 | — 40 | - - 11 | to 7 : 2 | at 4 | : 3 |

The Sum or Total of the whole is 40 Gallons.

Or

Or if you took the ſecond *Method*, you would have,

| *Gallons* | *s.* | *d.* | | | |
|---|---|---|---|---|---|
| 12 : $\frac{8}{20}$ at | 7 : | 6 | which is - - | L. 4 : | 15 : - |
| 6 : 4 at | 6 : | 9 | - - - | 2 : | 5 : - |
| 7 : 2 at | 5 : | - | - - - | 1 : | 16 : 8 |
| 13 : 2 at | 4 : | 3 | - - - | 2 : | 16 : 8 |
| 40 Gallons at | 5 s. | 10*d.* | per *Gall.* is | L. 11 : | 13 : 4 |

But if you are not abſolutely confin'd to a particular *Quantity* to be made up, after you have done as above, you may *multiply* to increaſe, or *divide* to diminiſh the *Total*, and the *Particulars* that make up that *Total*, by any *Numbers* whatever greater than *Unity*; and ſo you will have as many new *Totals* and *Particulars* as you pleaſe, and all at the ſame *Rates* or *Prices*. As for Inſtance,

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 19 | | 38 | | 57 | | 76 | |
| | 10 | | 20 | | 30 | | 40 | |
| Multiply | 11 | by 2 | 22 | by 3 | 33 | by 4 | 44, | *&c.* |
| | 20 | | 40 | | 60 | | 80 | |
| And the *Total* 60 will be | | | 120 | or | 180 | or | 240, | *&c.* |

Or thus of leſſening.

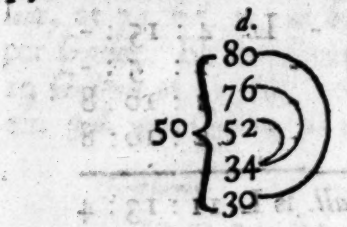
| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 19 | | $9\frac{1}{2}$ | | $6\frac{1}{3}$ | | | $4\frac{1}{4}$ |
| Divide | 10 | by 2 | 5 | by 3 | $3\frac{1}{6}$ | by 4 | &c. | $2\frac{2}{4}$ |
| | 11 | | $5\frac{1}{2}$ | | $3\frac{2}{3}$ | | | $2\frac{3}{4}$ |
| | 20 | | 10 | | $6\frac{2}{3}$ | | | 5 |
| And the *Total* 60 will be | | | 30 | or | 20 | or | | 15 |

Or you may work the foregoing, or any other *Queſtion* of this Nature, by *Decimals*; but, I think, the Method here us'd, will be full as good, and in moſt Caſes better for this particular *Rule*.

## QUESTION II.

*Suppoſe a Merchant ſhould write thus to his Factor: I would have you buy me the following Sorts of Linen*, viz. *at* 6 *s.* 8 *d. per Ell, at* 6 *s.* 4 *d. at* 4 *s.* 4 *d. at* 2 *s.* 10 *d. and at* 2 *s.* 6 *d. per Ell, to the Amount of* L. 500 *in the whole; and the Quan-*

*tity of each Sort, to be ſuch, as if it was all at 4 s. 2 d. per Ell; How much of each Sort muſt the Factor buy, to comply with his Orders?*




110 Total.

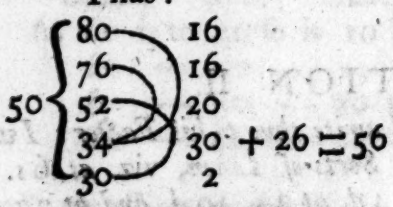
Here I find a *Total* that is to be the firſt Number in the *Rule of Three*, and the ſeveral third Numbers will be the Particulars that compoſe the ſaid Total. Now for the Second, you muſt find how much the whole Sum to be laid out will buy at the *Mean-rate*, by ſaying,

If 4 *s.* 2 *d.* or 50 *d.* buy 1 Ell, What will L. 500 buy? and the Anſ. will be 2400 Ells; then,

| | *Ells* | | *s.* | *d.* | | | | |
|---|---|---|---|---|---|---|---|---|
| As 110 is to 2400, ſo is | 20 to 436 | $\frac{11}{4}$ | at 6 | : 8 | L. 145 | : 9 | : 1 | : $\frac{11}{1}$ |
| | 16 to 349 | 1 | at 6 | : 4 | L. 110 | : 10 | : 10 | : 10 |
| | 16 to 349 | 1 | at 4 | : 4 | L. 75 | : 12 | : 8 | : 8 |
| | 28 to 610 | 10 | at 2 | : 10 | L. 86 | : 10 | : 10 | : 10 |
| | 30 to 654 | 6 | at 2 | : 6 | L. 81 | : 16 | : 4 | : 4 |
| | 2400 at 4 *s.* 0 *d.* is | | | | L. 500 | : — | : — | :— |

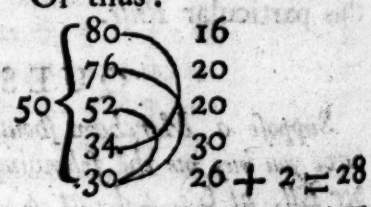
And ſo by working as many different Statings or Rules of *Three*, as there are different Particulars to make up the *Total*, you will have the Anſwers above; or if you do not like the above Proportions or *Quantities* of the particular *Sorts*, 'tis but *alligating* the Particulars differently, as under. *Note*, The 11, in the above *Example*, is the common *Denominator*, but is ſet at Top like a *Numerator*, for the Convenience of Room, and of being repeated but once.

Thus:




110 Total

Or thus:




114 Total.

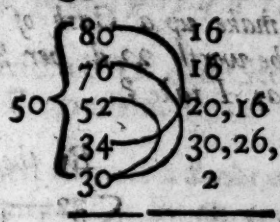
Or

Or thus:




Total 224

Or thus:




Total 128

Or any other Way as beſt pleaſes you, remembering only always to put a bigger and a leſs together, and then work as before, by the *Rule of Three*: Or, after you have found one *Quantity* by the *Rule* of *Three*, you may do the reſt by *Practice*, thus:

20 is found above, Page 322, to give 436 $\frac{4}{11}$

16 is $\frac{4}{5}$ of 20, ſo that $\frac{1}{5}$ is 87 $\frac{1}{11}$ this ſubſtracted leaves 349 $\frac{1}{11}$ for 16

then 28 is $\frac{7}{5}$ of 20 and $\frac{2}{5}$ is 174 $\frac{6}{11}$ which added gives 610 $\frac{10}{11}$ for 28

and 30 is $\frac{3}{2}$ of 20, ſo that $\frac{1}{2}$, which is 218 $\frac{2}{11}$ being added gives 654 $\frac{6}{11}$, for 30, as above.

From the above *Totals*, and Particulars being different, 'tis plain the Anſwers to the *Quantity* required, will be alſo different: And theſe may be us'd, as you would have a leſs or a bigger *Quantity*, of a *finer* or *coarſer Commodity*, &c.

The great Objection againſt this common Method of reſolving theſe Sort of Queſtions is, that the Anſwers are but few, and thoſe frequently in fracted Numbers, ſuch as no Weight or Meaſure can exactly comply with, as in ſome of the foregoing Queſtions; though, in the Nature of the Thing, many Anſwers in whole Numbers might be found; as in this that follows.

*If Wine worth* 32 *Pence a Quart is mix'd with other Sorts, worth but* 20 *Pence, and* 16 *Pence per Quart, and I would make up a Cask of* 14 *Gallons or* 56 *Quarts, that ſhould be worth* 22 *d. per Quart; How many Quarts of each Sort may I take?*

*By the common Way.*

| | | | |
|---|---|---|---|
| | 32 | | 6,2 |
| 23 | 20 | | 10 |
| | 16 | | 10 |

28 Total.

*Quarts. d.*

As 28 is to 56, ſo 8 is to 16 at 32 *per* Quart.
10 is to 20 at 20 ditto.
10 is to 20 at 16 ditto.

Here the *Anſwer* happens to come out in *whole Numbers*; but you may have eleven Anſwers in whole Numbers, as is ſet down below, any of which (at 32 *per* Quart) will perfectly anſwer the Condition of the *Queſtion*.

| | | | | | |
|---|---|---|---|---|---|
| 10 | at 32*d.* and | 44 | at 20*d.* and | 2 | at 16*d. per* Qrt. |
| 11 | - | 40 | - - | 5 | |
| 12 | - | 36 | - - | 8 | |
| 13 | - | 32 | - - | 11 | |
| 14 | - | 28 | - - | 14 | |
| 15 | - | 24 | - - | 17 | |
| 16 | - | 20 | - - | 26 | |
| 17 | - | 16 | - - | 23 | |
| 18 | - | 12 | - - | 20 | |
| 19 | - | 8 | - - | 29 | |
| 20 | - | 4 | - - | 32 | |

Theſe, and ſuch like Queſtions more compounded, are eaſily ſolved by an *Algebraick* Proceſs, which teaches to find the Limits above, or under which, the Quantity of each Sort cannot go: As here you cannot take more than 20 Quarts, nor leſs than 10, of the higheſt Price, to have the exact Anſwer in whole Numbers, *&c.* but as you are ſuppoſed not to know any thing of that moſt excellent Art called *Algebra*, we will cloſe this Matter, and go on to what is commonly called

*PRO-*

## *PROGRESSION* or *PROPORTION*,

*Which ordinarily is divided into* Arithmetical *and* Geometrical Proportion *or* Progreſſion.

*Arithmetical Progreſſion* is, when there is a *Series* of Numbers continually increaſing or diminiſhing by an equal Difference, as 1, 2, 3, 4, 5, *&c.* or 5, 4, 3, 2, 1; or 2, 4, 6, 8, 10, 12; or 20, 18, 16, 14, 12, *&c.* or 7, 16, 25, 34, 43; or 98, 77, 56, 35, 14, *&c.* Here the firſt *Series* or Set of *Numbers* increaſes by 1, and the ſecond decreaſes by 1; the third increaſes by 2, and the fourth decreaſes by 2; the fifth increaſes by 9, and the ſixth decreaſes by 21; and ſo of any other Increaſe or Decreaſe, bigger or leſſer, to any *Number* of *Terms* whatever. The Uſes of theſe *Numbers* are very many, eſpecially in ſuperior *Calculations*, a Touch of which you ſhall ſee hereafter; in the mean Time you ſhall be inſtructed in the common *Methods* of *Computation* in this *Rule*, by having three of the five following Particulars given, *viz.*

1. The *firſt-Term*, which may be either the greateſt or the leaſt *Term*, according as the *Series* increaſes or decreaſes.

2. The *laſt Term*, which may be either the greateſt or the leaſt *Term*, according as the *Series* or Set of given *Numbers* increaſes or decreaſes; as appears from the *Examples* above.

3. The *Number* of *Terms*, or how many there is in the given Set.

4. The *common Exceſs*, or by how much the following Numbers in the *Series*, exceed one another, as by *Unity*, or *one* in the two firſt *Examples*; by 2, in the 3d and 4th *Examples*; and 9 and 21, in the 5th and 6th *Examples*.

5. The *Total* or *Sum* of all the *Series* or *Numbers*, when added together.

Having the 1, 2, and 3 of the above five Particulars given, to find the 4th and 5th, that is the common Difference or Exceſs, and the Amount or Total of the Whole.

1. From the ſecond *ſubſtract* the firſt (when the firſt is the leaſt or contrarily) and *divide* the *Remainder* by the 3, made leſs by *Unity*, and the *Quotient* will be the 4, or *common Difference*.

2. *Multiply* the Sum of the 1ſt and 2d by the 3d, divide this Product by two, and the *Quotient* will be the 5th, or the Sum of all the *Terms* in the *Series*: Or you may multiply the

Sum

Sum of the 1ſt and 2d by half the 3d, and the Product will be the Anſwer or 5th ſought.

## *EXAMPLE* I.

*Suppoſe a Clock ſtriking round the ſeveral Hours upon the Dial-Plate, What is the Number of Strokes in all, and what is the common Difference between each Stroke?*

Anſwer, 78 the *Sum* of the *Strokes*, and the common Difference is 1, found thus:

1 the 1ſt of the 5 Things or firſt Term.
12 the 2d, of the 5 Things, or laſt *Term*.

13 the Total of the 1ſt and 2d ditto.
12 the *Number* of *Terms* or the 3d Thing.

2 | 156 Product.

78 the 5th Thing or *Total Number* of *Strokes*, which is the *Sum* of the *Series*.

*To find the 4th or common Difference.*

12 the *laſt Term*, which is the 2d of the 5 Things,
1 the *firſt Term*, which is the 1ſt ditto.

11 the *Remainder* to be *divided*.

12 the *Number* of *Terms* or 3d of the 5 Things.
1 ſubſtracted, as *per* Rule.

11 is the *Diviſor* to the *Remainder* above.

1 is the Quotient or 4th of the 5 Things, which is the common Exceſs or Difference ſought.

## *EXAMPLE* II.

*A certain Perſon had* 10 *Children, the Youngeſt of which was a Daughter, aged* 18 *Years, the Eldeſt a Son aged* 45, *the intermediate Children, ſome Sons ſome Daughters; but they all differed from one another, by an equal Age: A young Man makes his Addreſſes to the Youngeſt, and after ſome Time all Things are agreed upon, and he is to have for her Portion as many L.* 3 : 12 *Pieces of Gold as was the Sum of all their Ages:*

*Query,*

*Query, How much that is, and what is the common Difference of their Ages?*

Anſwer, L. 1134 the *Portion*, and 3 *Years* between each Child.

First Term 18
Laſt Term 45

Sum 63
Number of Terms 10

2 | 630 Product.

315 is the *Sum* of their *Ages*, which is the *Number* of *Pieces* of *Gold*, each L. 3 : 12, which is L. 1134, that he is to have for her *Portion*.

45 the laſt Term — 10 the Number of Terms.
18 the firſt Term. to be ſub. — 1 to be ſubſtracted.

9 | 27 the Dividend. — 9 the Diviſor.

Quot. 3 the common Difference between each Childs Age.

3. *The* 1, 2 *and* 4, *being given, to find the* 3d. *Subſtract* the *firſt* from the *ſecond*, or *contrarily*, when the firſt *Term* is the biggeſt, and *divide* the *Remainder* by the 4th; then *add* 1 to this *Quotient*, and that *Sum* will be the 3d, or *Number* of *Terms* ſought.

*EXAMPLE.*

*Suppoſe I buy a Bale of Cloth, for which I pay* 5 *s. for the firſt Piece, and* L. 5 : 3 : — *for the laſt Piece, How many Pieces were there in all, if the common Exceſs or Increaſe was* 2 *s. per* Piece? Anſ. 50 Pieces.

Shillings
103 in L. 5 : 3 the *Price* of the laſt *Piece*.
5 the *Price* of the firſt *Piece* to be ſubſtracted.

2 | 98 the *Rem.* to be *divided* by 2, the *common Exceſs*.

To 49 the Quotient,
add 1

Total 50 is the Number of *Pieces* in the *Bale*.

4. *The*

4. *The* 1, 2 *and* 5, *being given, to find the* 3. By the *Sum* of the *firſt* and *ſecond, divide* the 5th *doubled* or *multiply'd* by 2, the *Quotient* will be the 3d ſought.

*EXAMPLE.*

*Suppoſe a Merchant ſells a Bale of Cloth upon theſe Terms, viz. to have* 5 *s. for the firſt Piece and* 103 *s. for the laſt, and in the Whole he receives L.* 135 : 00 *for the Bale, I would know how many Pieces the Bale contained?*

Anſwer, 50 Pieces.

5 *s.* the firſt Piece.
103 the laſt Piece.

Diviſor 108 | 5400 | 50 Quotient.
| 540 | or N° of Pieces in the whole Bale.
0000

L. 135
20
2700
2
5400 Divid.

5. *The* 1ſt, 3d. *and* 4th *being given, to find the* 2d. From the *Product* of the 3d, and 4th, *ſubſtract* the 4th, and to the *Remainder* add the 1ſt, the *Sum* will be the 2d.

*EXAMPLE.*

*Suppoſe I ſell a ſmall Bale of Silk that weighs* 190 *Pounds, thus, for the firſt Pound I am to have a Farthing, for the ſecond Pound a Penny, for the third Pound* 7 *Farthings,* &c. *What muſt I have for the laſt Pound?* Anſ. 11 *s.* 10 *d.*

190 the Number of Terms or Pounds.
3 the common Increaſe.

570 Product.
3 Subſtract.

567
1 add the firſt.

Anſ. 568 *Farthings*, or 11 *s.* 10 *d.* for the laſt Pound.

6. *The* 1, 3 *and* 4 *being given, to find the* 5. From the *Product* of the 3d and 4th, *ſubſtract* the 4th, and to the *Remainder* add the *Double* of the *Firſt: Multiply* this *Sum* by the 3d, and *divide* the *Product* by *two*, the *Quotient* will be the 5th, or Sum of the *Series* ſought.

## *EXAMPLE.*

*Suppose I buy a Bale of Silk, that weighs* 190 lb. *and am to give a Farthing for the first Pound, and to increase* 3 *Farthings* per *Pound, How much must I give for the whole Bale?* Anſ. L. 56 : 6 : 1 $\frac{1}{4}$.

190 the Number of Terms.
3 the common Difference.

570 Product.
3 Subſtract.

567 Remainder.
2 add the Double of the firſt.

569 Total.
190 the Number of Terms.

51210
569..

2 | 108110 the Product to be divided by 2.

54055 the Quotient or L. 56 : 6 : 1 $\frac{1}{4}$ for the whole Bale.

13513 $\frac{1}{4}$

112|6 1

L. 56 : 6 : 1 $\frac{1}{4}$.

7. *The* 1, 3 *and* 5 *being given, to find the* 2d. *Subſtract* the *Product* of the 1 and 3, from the *Double* of the 5, and *divide* the *Remainder* by the 3, and the *Quotient* will be the 2d.

8. *The* 2*d*, 3*d*, *and* 4*th being given, to find the* 1*ſt*. *Subſtract* the *Product* of the 3 and 4 from the *Sum* of the 2d and 4th, and the *Remainder* will be the *firſt*.

9. *The* 2, 3, *and* 4 *being given, to find the* 5. *Subſtract* the *Product* of the 3 and 4 from the *Sum* of the 4, *added* to the *Double* of the 2d, and *multiply* the *Remainder* by the 3d; then *divide* this *Product* by *two*, and the *Quotient* will be the *fifth*, or *Sum* of all the *Terms*.

10. *The* 2d, 3d, *and* 5th *being given, to find the firſt. Divide* the *fifth* doubled, by the 3d, and from the *Quotient ſubſtract* the 2d, and the *Remainder* will be the *firſt.*

11. *The* 2d, 3d, *and* 5th *being given, to find the fourth. Subſtract* the *Double* of the Fifth from the double *Product* of the 2d and 3d, and divide the Remainder by the Product of the 3 multiply'd by it ſelf, after 1 is ſubſtracted from it, and the Quotient will be the fourth or common Difference ſought.

12. *The* 1ſt, 2d *and* 4th *being given, to find the fifth. Subſtract* the *Product* of the firſt *multiply'd* by it ſelf (which is called its *Square,*) from the *Square* of the 2d *divide* the *Remainder* by the 4th, and to the *Quotient* add the *Sum* of the 1 and 2, and divide this *Total* by two, and this laſt *Quotient* will be the *fifth.*

13. *The* 1ſt, 2d, *and* 5th *being given, to find the fourth. Subſtract* the *Square* of the *firſt* from the *Square* of the 2d, and divide the *Remainder* by the *Double* of the *Fifth,* made leſs by the *Sum* of the 1ſt and 2d, and the *Quotient* will be the *fourth* ſought.

14. *The* 1ſt, 3d, and 5th *being given, to find the fourth. Double* the *Product* of the 1ſt and 3d, *ſubſtract* this *Double* from the *Double* of the 5th, divide the *Remainder* by the *Square* of the 3d, made leſs by the 3d, and the *Quotient* will be the *fourth* ſought.

15. *The* 3d, 4th, and 5th *being given to find the firſt. Divide* the *Double* of the fifth by the Double of the 3d, to the *Quotient* add half of the 4th, from that *Sum* ſubſtract half the *Product* of the 3, multiply'd by the 4th, and the *Remainder* is the 1ſt ſought.

16. *The* 3d, 4th *and* 5th *being given, to find the* 2d. *Divide* the 5th doubled by the 3d doubled, and to the *Quotient* add half the *Product* of the 3d and 4th, from this *Sum* ſubſtract the Half of the *Fourth,* and the *Remainder* is the 2d ſought.

There are four other Propoſitions belonging to this Rule, but as the Extraction of the Square-Root is wanted to perform them, and that has not yet been taught; and perhaps too much already has been ſaid upon this Head, it being a Rule more of Curioſity than us'd in Buſineſs, I ſhall not purſue this Subject any further; but go on to

*Geometrical*

## *Geometrical* PROGRESSION,

Which is when a Series of Numbers are ſo circumſtanced, that when the preceding Number is the Diviſor, and the ſucceeding Number the Dividend, the *Quotients* are all alike; as in theſe that follow, 2, 4, 8, 16, and 3, 9, 27, 81, &c. here the common Ratio is 2 and 3, that is, the following Numbers are 2 Times, or 3 Times as much as the preceding Numbers; and theſe Numbers are generated by multiplying the firſt by the common *Ratio* or *Quotient*, and that Product again by the ſame, and that Product again by the ſame, &c. till you have gone on as far as you want; but if you begin with the large Number, and ſo continually decreaſe in the ſame Ratio, as 16, 8, 4, 2; or 81, 27, 9, 3, then the following Terms, are produced by dividing by the common Ratio, as appears very plainly by what is before you; for if you divide 16 by 2, the *Quotient* is 8, and that Quotient again by 2, the *Quotient* is 4, and that again by 2, you will have the 4th Term 2; and ſo of any other Numbers increaſing or decreaſing, by any other *Ratio* or given *Proportion*. The firſt and laſt *Terms* of any ſuch *Series* of *Geometrical Proportionals*, are called the *Extreams*, and the intermediate *Terms* are called *Means*, which *Means*, if required to be known, are found by that Part of *Diviſion* commonly called the *Extraction* of *Roots*, not yet *taught*; therefore we will only here touch upon ſuch Parts of *Geometrical Progreſſion*, as may be done without ſuch laborious Proceſſes; for which Purpoſes you muſt note, *That the Product of any two Extreams, is equal to the Product of any two Means, equally diſtant from them, in any continued Series, whether increaſing or decreaſing*; as appears from the following Series.

2, 4, 8, 16; here 16 and 2, when *multiplied* together, produce 32, and ſo do 4 and 8; or if the Number of *Terms* be *odd*, as 243 : 81 : 27 : 9 : 3, the *Mean* or *middle Term*, *multiply'd* into itſelf or *ſquared*, will be equal to the *Product* of any two other *Terms*, equally diſtant on each Side from it. As here the 3d or middle *Term* 27 by 27 is 729, and 243, the firſt by 3; the fifth Term is alſo 729, as is 81, the 2d, and 9 the 4th Term; and this will always be the Caſe, let the Number of Terms be what they will: From whence it follows, that the four *Numbers* in every *Rule* of *Three* Operation, *viz.* the 3 given, and the 4th found, are Numbers in continual *Geometrical Proportion*. You are likewiſe to obſerve, *that every Term that ſtands firſt in a*

*Series, is called the Antecedent, and that which follows is called the Conſequent; and that every Number in a Series, except the firſt and laſt, may be both an Antecedent and a Conſequent:* As above, in 2, 4, 8, 16; here 2 bears the ſame *Ratio* or *Proportion* to 4, as 8 does to 16, that is, each of the *Antecedents* ½ of its *Conſequent:* So likewiſe the ſame is to be obſerved, if you ſay, as 2 is to 4, is ſo 4 to 8; and as 4 is to 8, ſo is 8 to 16, *&c.* From this laſt Obſervation may be drawn this General Rule: *As* 1 *Antecedent is to its Conſequent, ſo is the Sum of all the Antecedents to the Sum of all the Conſequents in the given Series.* As, Suppoſe the 2d *Series*, 243, 81, 27, 9, 3. Here the *Sum* of all the *Antecedents* 243, 81, 27, 9, which is 360, is to 120, the *Sum* of all the *Conſequents*, 81, 27, 9, 3; as 243 is to 81, or as 81 is to 27, or as 27 is to 9, or as 9 is to 3: And to ſave the Trouble of continual *Addition*, in finding the *Sum* of any ſuch *Series*, you muſt have ſomething given whereby to find the reſt, *as the firſt Term, the laſt Term, and common Ratio. Multiply the laſt Term and the Ratio together, and ſubſtract the firſt Term from this Product, and divide the Remainder by the Ratio, made leſs by Unity, and the Quotient will be the Sum of the whole Series.* Or you may

*Subſtract the Square of the firſt Term from the Product of the ſecond and laſt Term, and divide the Remainder by the ſecond Term, made leſs by the firſt, and the Quotient will be the Sum of all the Series.*

But as the laſt *Term* is ſometimes difficult to come at, 'twill be neceſſary to obſerve, that to any Series of *Geometrick Proportionals*, that do not begin with *Unity* or 1, you may ſuperſcribe a *Series* of *Arithmetick Proportionals*, beginning with *Unity*, whoſe common *Difference* is alſo *Unity*; but if your *Geometrick Proportionals* begin with *Unity*, then your *Arithmetick Proportionals* muſt begin with 0, and the ſecond Term muſt be 1, *&c.* And theſe Numbers, either really thus ſet down, or imagined to be ſo ſet down, are called the *Exponents* or *Indices* of the Numbers to which they correſpond below, thus:

*Arithmetical Propor.* 1, 2, 3, 4, 5, 6, 7, called *Indices*
To 2, 4, 8, 16, 32, 64, 128, *Geo. Propor.*

Or,

0, 1, 2, 3, 4, 5, 6 *Indices.*
1, 3, 9, 27, 81, 243, 728, *&c.* The *Addition* or *Subſtraction* of any two of theſe *Indices* will agree to the *Product* or *Quotient* of their correſponding *Geometrical Proportionals*;

that

that is to say, if you *add* any two *Indices* together, as supposes the 6th and 7th in the first *Series* above, the Sum will be 13; by which you are to understand, that if you multiply the 64 and 128, the corresponding Numbers in the *Geometrical Series* together, the *Product* will be 8192; which shews, that if you continued that *Series* on to 13 *Terms*, the last *Term* would be 8192; and in the second *Series*, the like *Multiplication* produces a *Term* one Place more than is the *Sum* of the *Indices*, because the first *Term* is 0. As, suppose I add the *Indices* 5 and 6 together, the *Sum* is 11, and the *Product* of 243 by 729, their corresponding Numbers, is 177147; and this will be the 12th *Place* in such a *Series*, were the Terms continued, as may be easily try'd. Now by having the first *Term*, and the common *Ratio* given, I can with little trouble get the last *Term* or Number, without being obliged to get the whole Number of Terms.

## *EXAMPLE.*

*Suppose a fine Horse, dressed in curious Trappings, and laden with a Crown richly bedecked with Diamonds, &c. was purchased as a Present for some great Prince, upon the following Conditions,* viz. *to pay a Farthing for the first Nail of his Shoe, two for the second, four for the third, 8 Farthings for the fourth; and so on for the Whole, which was 7 in each Shoe, or 28 in all, What must be paid for the last Nail? and what for the Whole,* viz. *the Crown, Horse and Trappings?*

Answer, L. 139810 : 2 : 8 for the last *Nail*, and L. 279620 : 5 : 3 ¾ for the Whole.

Here I set down a few of the first Terms, then I add 3 and 3 together, and multiply 8 and 8 together, the Sum of the *Addition* is 6, and the *Product* of the *Multiplication* is 64 for the 7th Term.

0, 1, 2, 3
1, 2, 4, 8

Thus 3 + 3 = 6, and 8 multip. 8 = 64, and 6 + 6 = 12 and 64 by 64 = 4096 the 13 Term; then 12 + 12 = 24, and 4096 by 4096 = 16777216 the 25th Term; and 24 + 3 = 27, and 16777216 by 8 = 134217728, the 28th Term, or Value of the last Nail in *Farthings*. Then,

134217728 the laſt *Term*,
multiply'd by 2 the common *Ratio*, and from
268435456 *Product*,
ſubſtract 1 the firſt *Term*, and
268435455 remains for a *Dividend*.

Then from 2 the common *Ratio*
ſubſtract 1
Remains 1 for the *Diviſor*.

Now as *Unity* or 1 neither *multiplies* nor *divides*, conſequently the *Dividend* above, muſt be alſo the *Quotient*, which is the *Sum* of all the *Series* or Value of the *Horſe* and *Crown* in *Farthings*, which is L. 279620 : 5 : 3 ¼. But as all Queſtions, anſwerable by this and the laſt Rule, are much better underſtood, by having a little Skill in *Algebra*, I ſhall omit ſaying any more of it here, and juſt give you a Sketch of what is called

## *COMBINATION*, and *PERMUTATION*,

That is, to find how many Times the Order or Place of any propoſed Number of Things may be changed or varied, or how often a leſs Number of Quantities may be taken out of, or are contained in a great Number, without having any Conſideration of their Place.

As, how many Variations may be made with the whole Alphabet of Letters; or Changes rung upon any Number of Bells, *&c.* or to know how many Combinations of 2, 3 or more Letters may be made in the whole Alphabet, or Part of it, *&c.*

The Method of performing this, is as follows: Set down the whole Number of Terms given, and they will form a Series of Numbers in *Arithmetical Progreſſion*; then multiply the firſt by the ſecond, and that Product by the third, *&c.* till you have gone through all the Terms, and the laſt Product is the Anſwer ſought.

## *EXAMPLE* I.

*How many ſingle Changes may be rung upon* 8 *Bells?*
Anſwer, 40320.

| *Bells.* | *Changes.* |
|---|---|
| 1 | 1 |
| 2 | 2 |
| 3 | 6 |
| 4 | 24 |
| 5 | 120 |
| 6 | 720 |
| 7 | 5040 |
| 8 | 40320 |

After the like Manner may the *Changes* of any other Number of Things be found; as of 12 *Bells*, 24 *Letters*, &c. and this is called *Permutation*.

## *EXAMPLE* II.

*Six Gentlemen meeting at an Inn, upon the Road, were ſo pleas'd with their Landlord's Entertainment, and one another's Company, that they agreed to ſtay till they had drank a Glaſs of Wine, for every different Poſition that they and their Landlord could be put in. Now, upon Suppoſition, that* 16 *Glaſſes make a Quart, and that each Glaſs was worth* 1 *d.* $\frac{1}{2}$, *How many Bottles of Wine did they drink, and how much muſt each of the ſix pay for his Share of the Reckoning?*

Anſwer, 5040 *Glaſſes*, or 315 *Bottles*, worth L. 31 : 10, which is five *Guineas* per *Man*.

*Combination* is thus performed: Count the whole Number of Things to be combin'd, as whether they are, 1, 2, 3, 4, 5, 6, 7, 8, *&c.* then beginning with the *Unit*, multiply continually as many of the leaſt of thoſe Numbes as your *Combination* is to conſiſt of, and the laſt *Product* is to be your *Diviſor*; then *multiply* continually, as many of the laſt or greateſt of thoſe Numbers, and the laſt *Product* reſulting therefrom, ſhall be your *Dividend*; with theſe two, *Diviſion* being made, the *Quotient* will be the Number of *Combinations*, conſiſting of 2, 3, 4, *&c. Members*, that can be had in the whole Number propos'd.

## *EXAMPLE.*

*How many* Combinations *of* 3 *are there in* 6, viz. *Suppoſe the* 6 *Letters*, a, b, c, d, e, f, *How many different Words or Syllables, of* 3 *Letters each, are contained in them?*

Anſwer, 20, found thus:

1 mul-

1 multiply'd by 2 and 2 the *Product* by 3 — 6 the *Pro.* will be *Divis.*

6 multiplyd by 5 and 30 the *Product* by 4 — 6 | 120 *Prod.* will be a *Divid.* and 20 the *Quot.* or *Answer.*

Proved thus:

| | | |
|---|---|---|
| abc | ade | bed |
| abd | adf | cde |
| abe | aef | cdf |
| abf | bcd | cef |
| acd | bce | def |
| ace | bcf | dbf |
| acf | bef | |

Again,

*Upon the Cards, at the Game called* Cribbidge, *How many different Fifteens can there be made out of the* 4 *Fives?*
Answer, 4.

| | | |
|---|---|---|
| 1 | 4 | |
| 2 | 3 | |
| 2 | 12 | |
| 3 | 2 | |
| 6 *Divisor.* | 24 *Dividend.* | 4 *Quotient.* |

Again,

*How many* Cribbidges, *or different* Combinations *of five* Cards *are to be made out of a Pack consisting of* 52 Cards?
Answer, 2598960.

1.

| | | |
|---|---|---|
| 1 | 52 | 6497400 |
| 2 | 51 | 048 |
| 2 | 52 | 519792000 |
| 3 | 260. | 25989600. |
| 6 | 2652 | *Divid.* 311875200 |
| 4 | 50 | |
| 24 | 132600 | *Quot.* 2598960 |
| 5 | 49 | |
| 120 *Divis.* | 1193400 | |
| | 530400 | |
| | 6497400 | |

Again, *How many different* Tricks *of* Cards *are to be made out of a whole* Pack, *or how many* Combinations *of* 4 *are there in* 52 *?*

Anſwer, 270725 different Tricks.

For by the Work above, it's evident that 24 will be the *Diviſor*, and 6497400 the *Dividend*; from whence, by common *Diviſion*, the *Quotient* or Number of *Tricks*, will be found to be 270725.

## On the *Dice*,

The Number of *Chances* on *one*, *two*, *three*, *four*, &c. *Dice*, are in a *Geometrical Progreſſion*, whereof the Number of *Dice* is the Number of *Terms*, and the *Chances* on one *Die*, viz. 6. is the *Ratio* and firſt *Term:*

So that,

On 1, 2, 3, 4, 5, 6 *Dice*,

There is 6, 36, 216, 1296, 7776, 46656 *Chances*; and ſo you may go on to any other Number, and by the above ſmall Table, you may know what Odds any particular Chance upon 1, 2, 3, 4, 5, or 6 *Dice*, hath againſt it: As for inſtance, 'tis 5 to 1, that with 1 Die a Perſon does not throw any particular Face or Number of Spots upon that *Die:* As, ſuppoſe 4, then there are 1, 2, 3, 5, 6,

againſt it; ſo if 'twas 3, then 1, 2, 4, 5, 6 are againſt it: And ſo of any other.

Two *Dice* have 36 *Chances*, ſo that it is 35 to one that you don't throw any particular *Chance*; only you muſt take Notice, that if you don't pitch upon ſome one of the *Doublets*, viz. the two *Aces*, two *Duces*, two *Treys*, &c. that the *Dice* muſt be mark'd with Ink, *&c.* to determine which *Die* ſhall caſt 1, 2, 3, *&c.* and which the 4, 5, 6, becauſe all the other *Chances*, beſides the *Doublets*, have two Ways of expreſſing the ſame Thing: As, Suppoſe *A* lays *B*, that with two *Dice*, he don't throw a *Trey* and a *Duce*, if it is not determin'd which *Die* ſhall throw the *Trey*, and which the *Duce*, the *Thrower* will have two *Chances*, and conſequently then the *Odds* againſt him is but 17 to 1, becauſe there are two *Chances* to win, and 34 to loſe; but if the *Wager* was ſtill more indefinite, and the *Thrower* was to throw *Cinque* or 5, without Reſtraint, then the *Odds* would be but 8 to 1, becauſe there are 4 Ways of throwing 5; and conſequently, 32 to miſs it; ſo that the Odds muſt be theſe two Numbers ſet Fraction-wiſe, and reduced to its loweſt Terms, thus: $\frac{4}{32}$, which is $\frac{1}{8}$, or 8 to 1.

From hence may eaſily be known the *Odds* at the *Games*, called *Back-Gammon*, *Hazard*, &c. for the ſeveral *Chances* on two *Dice* being 36, all the particular Chances that can be thrown on them, are expreſſed in the following Table.

| | | | | | |
|---|---|---|---|---|---|
| 11 | 21 | 31 | 41 | 51 | 61 |
| 12 | 22 | 32 | 42 | 52 | 62 |
| 13 | 23 | 33 | 43 | 53 | 63 |
| 14 | 24 | 34 | 44 | 54 | 64 |
| 15 | 25 | 35 | 45 | 55 | 65 |
| 16 | 26 | 36 | 46 | 56 | 66 |

From whence you may obſerve, there is 11 that has an *Ace*, and 25 that has not an Ace; 11 that has a Duce, and 25 that has not, *&c.* So that it is 25 to 11 that you don't throw any particular Number of Spots on either Die, at one Throw; 'tis alſo farther remarkable. That there are 6 *Chances* that amount to 7 each, and 15 above 7, and as many under it; ſo that 'tis 5 to 1 that a Perſon does not throw the *Number* 7 at one Throw, with two *Dice*. You may alſo obſerve, that there are 6 *Doublets*, or two of one Number, on each Die, *viz.* 1 and 1, 2 and 2, 3 and 3, 4 and 4, 5 and 5, 6 and 6; ſo that 'tis alſo 5 to 1 that the

the Thrower don't throw *Doublets* of any Sort at all; but 'tis 35 to 1 that he don't throw a particular *Doublet*, as 5 and 5, 1 and 1, &c. at one Throw. 'Tis observable also, that the *Chances* in the above *Table*, go in an *Arithmetical Progression*, both above and below 7; for there is but one *Chance*, to throw either 1 and 1, or 6 and 6; but *two* to throw 3 or 11, *three* for 4 and 10, *four* for 5 and 9, and *five* for 6 and 8; so that any two *Chances* being thrown, the *Odds* between them are immediately known, by knowing their Distance from 7. As, suppose 4 and 9, 'tis 4 to 3 that 9 comes before 4, and so of any other *Chance* you shall pitch upon; but if the two *Chances* are equally above and below 7, 'tis an even *Wager* that one comes as soon as the other, provided no unfair Practices are made use of.

Upon three Dice there are 216 Chances, &c. as was noted before; from whence Persons may easily know how much they are impos'd on by those *Vermin* that go about with *Boards*, that have *Money* placed upon particular *Chances* of 4, 5, or 6 *Dice*: As, suppose upon 36, with 6 *Dice*; here there is but 1 *Chance* to win, and 46655 to lose; so that suppose a Person gives 6*d*. for such a *Throw*, the *Stake* against it ought to be L. 1166 : 7 : 6, which, perhaps, is commonly but about L. 3 or 50 *Shillings*, &c.

As we have already gone thus far, we will add a small *Table*, with its *Explanation*, relating to this *Subject*, that for its Curiosity may perhaps be an agreeable *Amusement*.

*The Number of Dice.*

| 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|

*The Number of Chances.*

| 1 | 1 | 1 | 1 | 1 | 1 |
|---|---|---|---|---|---|
| 2 | 4 | 8 | 16 | 32 | 64 |
| 3 | 9 | 27 | 81 | 243 | 729 |
| 4 | 16 | 64 | 256 | 1024 | 4096 |
| 5 | 25 | 125 | 625 | 3125 | 15625 |
| 6 | 36 | 216 | 1296 | 7776 | 46656 |

## *EXPLANATION.*

The upper Line 1, 2, 3, *&c.* ſhews how many Dice are ſuppos'd to be thrown at once, where the greateſt Number is 6; and after the ſame Manner you may go on to ſix *Thouſand.* The particular Lines of the firſt *Row*, on the *Left-hand*, ſhews the Number of *Faces* and *Spots* upon each *Face*, that each *Die* has. The *Second*, *Third*, *Fourth*, *Fifth* and *Sixth* Lines ſhew the Number of *Chances* that may be thrown by the reſpective Number of *Dice*, whoſe higheſt *Face* or Number of *Spots* is that in the firſt *Column*. The laſt *Line* is the *Total* of all the *Chances* that the whole Number of *Dice* can throw.. As for *Example*, with 1 *Die*, there may be thrown 6 *Chances* in all, that is *one* of 1 *two*, when you don't exceed 2, *&c.* So with 2 *Dice* you may throw 4 *Chances*, and have neither a 3, 4, 5, nor 6, *viz.* 1, 1, and 1, 2, and 2, 1, and 2, 2; with 3 *Dice*, you may throw 27 *Chances*, in which there ſhall be neither a 4, 5 or 6; ſo with 4 *Dice* you may throw 256 *Chances*, which ſhall have neither a 5 nor 6 among them; with 5 *Dice* you may throw 243 *Chances* that ſhall have neither 4, 5, nor 6 among them; and with 6 *Dice* you may throw 729 *Chances* that has neither 4, 5 nor 6; *&c.* You are alſo to *Note*, that each *Line* of the 2, 3, 4, 5 and 6 *Rows* ſhew the Number of *Chances* that are to be thrown, when you leave out ſo many *Faces* as are the Number of *Lines* under that you chooſe.

## *EXAMPLE.*

In the 5th *Line* ſtands the following *Figures*, 5, 25, 125, 625, 3125 and 15625; and this ſhews you, that you may, upon two *Dice*, throw 25 *Chances*, and leave out any one particular *Face* that you ſhall pitch on: As, ſuppoſe you would have never a 4, then your two *Dice* may throw 25 *Chances* without 4, and 11 with it, in all 36 *Chances*; the ſame may be done by 1, 2, 3, 5 or 6. Again, with three *Dice* you may throw 125 *Chances*, and leave out any one particular Face upon all the three *Dice* that you may object againſt; with four *Dice* there are 625 Chances, that may be thrown, and leave out any one particular Face upon all the four *Dice*, *&c.*

In the fourth Line ſtands 4, 16, 64, 256, 1024, 4096, which ſhews, that there are ſo many *Chances* to be thrown,

when you leave out any two *Faces*, as is the Number of *Dice* under which thoſe particular Numbers ſtand; ſo

In the third Line the Numbers 3, 9, 27, 81, 243, 729, ſhew the Number of *Chances* that are to be thrown, when any particular three *Faces* are to be left out. *Note*, By the Number of Faces, is meant the ſame Number of Spots upon each *Face* in each Die. As, ſuppoſe upon three Dice, I would leave out the 1, 2, 3 Faces, I mean, there muſt be never a Face of 1, 2 or 3 Spots in the Caſt. This Subject would take up a very large *Volume* to handle it fully; ſo that thoſe who would have it compleat, may conſult Mr. *De Moivres's Doctrine* of *Chances*, where they will find ſufficient to ſatisfy their utmoſt Curioſity.

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## CHAP. X.

### *Of raiſing* POWERS *and extracting* ROOTS.

AS there is frequent Uſe of what is called raiſing *Powers*, and extracting *Roots* from given *Powers* already rais'd, 'twill be proper here to explain what theſe *Terms* mean, and the *Methods* of performing the ſeveral *Operations* neceſſary to effect the ſame: And firſt, *To raiſe a Power*, is to *multiply* any given Number into itſelf, 1, 2, 3, 4, 5, 6 or more Times, as Occaſion may require; and indeed the *Theory* of this Part of *Arithmetick* is by much the beſt explain'd by an *Algebraick* Proceſs, from whence the Reaſon of the Work appears ſelf evidently; but as we have not yet meddled with that Part of *Abſtract-Arithmetick*, we will do what we can to explain it *Numerically*, as plainly as poſſible: Wherefore you are to obſerve,

1. That the *Number* given to be *rais'd* to a *Power*, be it *ſmall* or *large*, a *Fraction* or *whole Number*, is called the *Root* or firſt *Power*, that is, the *Source* or *Spring* from whence ariſes the ſeveral *Powers* afterwards, and this is perform'd by *one* or more *Multiplications* of it *ſelf*, into it *ſelf*; that is, Suppoſe 6 was given to be *rais'd* to the 3d, 4th, or 5th

Power 5

Power:

| | |
|---|---|
| Firſt, ſet down the given *Root* or firſt *Power* | 6 |
| Then *multiply* it by itſelf *thus* | 6 |
| And this *Prod.* is called the 2d *Power* or the *Square* | 36 |
| Then multiply this Product again by | 6 |
| And this new *Prod.* is called the 3d *Power* or *Cube* | 216 |
| Then *multiply* this *Product* again by | 6 |
| And this new *Prod.* is called the 4th *Pow.* or *Biquadrate* | 1296 |
| Then *multiply* this *Product* again by | 6 |
| And the new *Prod.* is called the 5th *Power* or *Sur-ſolid* | 7776 |

And ſo you may go on as far as you pleaſe, only noting to call the laſt *Product* a *Power* one *Degree* higher than the *Number* of *Multiplications* or *Involutions* made uſe of. As you ſee above, the *Product* of the firſt *Multiplication* is called the 2d *Power*, the Product of the ſecond *Multiplication* is called the 3d *Power*; of the 3d, the 4th *Power*, &c. Now any *Power* of any *Root*, may be given to be rais'd to any other *Power*; and in that Caſe, though you know the given *Number* or *Root* is the 3d, 4th, 5th, 6th, &c. *Power* of ſome other *Number* or *Root*, yet you take no Notice of that, but work as above, in the ſame Manner, as though it were not ſo: As, ſuppoſe the Number 7776 was given to be rais'd to the 2, 3, 4, &c. *Power*, you muſt *multiply* it continually *once*, *twice*, *thrice*, &c. as before, although this Number given, is the 5th Power of 6.

*EXAMPLE.*

| | |
|---|---|
| *What is the Cube or 3d Power of* | 7776? |
| Multiply by | 7776 |
| | 46656 |
| | 54432 |
| | 54432 |
| | 54432 |
| And the *Product* is the *Square* or 2d *Power* | 60466176 |

And

And the *Product* is the *Square* or 2d *Power* 60466176
Multiply again by - - 7776

362797056
423263232
423263232
423263232

And the *Product* is the *Cube* or 3d *Power* 470184984576

And so of any other Number whatever, only you are to Note, that the *Scale* of *Powers* are as the *Indices* in *Arithmetick Progression*, and the produced *Powers* are as the *Terms* of a *Series* in *Geometrick Progression*, whose common *Ratio* is the *Root* or *Number* given, or pitch'd upon; as will more evidently appear by the following Table of Roots and Powers.

| *Roots or first Power.* 2 | *Squares or 2d Power.* | *Cubes or 3d Power.* 3 | *Biquadrats or 4th Power.* 4 | *Surfolids or 5th Power.* 5 | *Power.* 6 | *Power.* 7 | *Power.* 8 | *Power.* 9 &c. *Indi.* |
|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2 | 4 | 8 | 16 | 32 | 64 | 128 | 256 | 512 |
| 3 | 9 | 27 | 81 | 243 | 729 | 2187 | 6561 | 19683 |
| 4 | 16 | 64 | 256 | 1024 | 4096 | 16384 | 65536 | 262144 |
| 5 | 25 | 125 | 625 | 3125 | 15625 | 78125 | 390625 | 1953125 |
| 6 | 36 | 216 | 1296 | 7776 | 46656 | 279936 | 1679616 | 10077696 |
| 7 | 49 | 343 | 2401 | 16807 | 117649 | 823543 | 5764801 | 48453209 |
| 8 | 64 | 512 | 4096 | 32768 | 262144 | 2097152 | 16777216 | 134217728 |
| 9 | 81 | 729 | 6561 | 59049 | 531441 | 4782969 | 43046721 | 387420489 |

This

This *Table* conſiſts of nine Lines, included within the double Lines; the firſt whereof is all 1's or *Units*, and all the reſt are ſo many *Terms* of a *Geometrical Series*, whoſe 1ſt *Terms* and common *Ratio* are both alike, and the *Series* are produced by *multiplying* the firſt *Term* by it *ſelf*, and that *Product* again by the firſt *Figure*, &c. The *Line* immediately above the *Table* contains the *Indices* of the ſeveral *Powers*, to which the *Root* or firſt *Power*, in the firſt *Row* upon the *Left-hand*, is ſuppos'd to be rais'd; and the ſeveral perpendicular *Lines* or *Rows* that ſtand under the ſaid *Indices*, are the *Powers* themſelves of the nine *Digits* or ſingle *Figures*: Now here, as before in *Geometrical Progreſſion*, Suppoſe you had the 4th and 5th *Powers* given, to find the *Power* of the ſame *Root*, that was equal to the *Sum* of theſe *Indices*, viz. the 9th, by by *multiplying* 16, the 4th, and 32, the 5th *Power* of 2, together, you have 512 for the *Product*, which is the 9th *Power* of 2, without a continual *Involution* or *Multiplying* by 2, the common *Ratio*; and ſo of all others. And by *involving* or *multiplying* 512 into itſelf, you will have 262144, the 18th *Power* of 2, becauſe 9, the *Indice* added to 9 is 18; and this Trouble of Involution may be ſaved, if your firſt Line were continued ſo far, that you could find in it the *Square*, *Cube*, &c. of the *Power*, to which you would raiſe any *Power*: As in this Inſtance above, the *Indice* 9 added to it *ſelf*, produces the *Square* of it *ſelf*, or the 18th *Power* of 2. Now the *Square* of 2 is 4, therefore the 9th *Power* of 4 will be the ſame Thing as the 18th *Power* of 2, viz. 262144, as appears by the *Table*: So if it was required to produce the 16th *Power* of 3, you might either *multiply* 2187, the 7th *Power*, and 19683 the 9th *Power* of 3 together, or you may *multiply* 6561, the 8th *Power*, by itſelf, and either of them will produce 43046721, the 16th *Power* of 3; becauſe the *Sum* of 7 and 9, or 8 and 8, the *Indices* of the inferior *Powers*, produce 16 for their *Total*: Or if you take the 8th *Power* of 9, becauſe 9 is the *Square* or 2d Power of 3, 'twill be all one, as appears by the *Table*; and ſo of any other *Power*. Thus much may ſuffice for raiſing of *Powers*, called *Involution*; but the chief Uſe of this *Table* is in

*Evolution*, or *extracting* of *Powers*,

Which is the *Art* of finding ſuch a *Root* or *Number*, that when *Squared*, *Cubed*, &c. will produce the *Number* or Power given, to have ſuch Root extracted out of it; and here, very frequently, after the *Proceſs* is over with the given *Figures*, there

there happens to be a *Remainder*, the Value whereof cannot be exactly found; but by adding *Cyphers* and continuing the Work, you may approximate ſufficiently near for any Purpoſe of *Buſineſs*, though you cannot arrive at a *Mathematick* or an *Arithmetick* Exactneſs.

When any *whole Number* is given to *extract* the *Square*, *Cube*, &c. *Root*, or the Root of the 2d, 3d, 4th, &c. *Power*, make a *Dot* or *Mark* over, or under the *Units* Place, and then count ſo many *Figures* towards the *Left-hand*, as is the *Index* of the *Power* you are to extract, and there make another *Dot* or *Mark*, and ſo continue counting towards the *Left-hand*, till you have gone through the whole *Number* of *Figures* given; and ſo many *Dots* or *Marks* as are thus made, will be the *Number* of *Figures* the *Root* muſt conſiſt of.

As, Suppoſe 'twas required to extract the *Square*, *Cube*, &c. *Root* of 387420489.

For the *Square Root* it muſt be *pointed* at *Unity*, and at every two Figures from *Unity*, thus - - - 387420489

For the *Cube Root*, it muſt be *pointed* at *Unity*, and at every three Figures from *Unity*, thus - - 387420489

Where you will obſerve that the *Square* has 5 *Points*, which ſignifies that the *Root* will conſiſt of 5 *Figures*, and the *Cube Root* has but 3 Points or Figures.

But if the given Number be a mix'd Number, if the Fractional Part is not already a *Decimal*, make it one by the Rule given, *Page* 168. Point the whole *Number* Part, as above; and then for the *Decimal Part*, count two Places from the *Units* Place, for the firſt Point, and ſo count 2 Places from thence for the other *Dots*, for the *Square*, three Places for the *Cube*, &c.

*To* Extract *the* Square-Root, *or* Root *of the ſecond* Power, *out of any given* Number *or* Reſolvend.

*RULE.*

*The given Number being ſet down and pointed, as above directed; by the foregoing* Table, *ſee what is the neareſt* Square Number *to thoſe Figures that belong to the firſt* Dot *or* Point *towards the Left-hand, which does not exceed them*; which being found, ſet down the ſaid *Square* under the *Figures* of that firſt *Dot*, and the *Root* by itſelf, as you do the *Quotient* in *Diviſion*; thus,

What is the *Square Root* of 43046721 the whole *Reſolvend*?

43046721 (6
36

Here the given *Number* being pointed, the *Figures* 43 belong to the firſt *Dot*, towards the *Left-hand*, the neareſt *Square Number* to which that doth not exceed them, is 36, the *Root* whereof is 6; which being ſet down as above, *then ſubſtract the* 36 *from* 43, *and the Remainder is* 7, *to which I bring down the Figures of the next Dot*, viz. 04, *and that makes* 704 *for a new* Reſolvend, *to find the next Figure, or ſecond Figure of the Root; to do which, I double the* 6 *or firſt Figure of the Root already found, and it makes* 12; *with this* 12 *I divide the two firſt Figures of the* 704, viz. 70, *and the Quotient is* 5; *this* 5 *I ſet before the* 6 *and the* 12, *and then it makes the Quotient or Root* 65, *and the* 12, *or* Diviſor, *becomes* 125, *which* 125 *I multiply by the ſaid* 5, *and the Product* 625 *I ſet down under the* 704, *and ſubſtract, and to the Remainder* 79 *I bring down* 67, *the Figures of the third* Dot, *and* 7967 *becomes a new* Reſolvend; *the* 3 *firſt Figures of which becomes a Dividend, and the Diviſor is the* 65 *doubled, or* 130; *then I proceed in every reſpect as with the Figure* 5, *and ſo from one Dot or Figure in the Root to another, till all is done, as in the following Examples at large.*

43046721 (6561 Root.
36

125)704 Reſolvend.
5)625 Subtrahend.

1306)7967 Reſolv.
6)7836 Subtra.

13121)13121 Reſolv.
1)13121 Subtra.

Remains ....

Anſ. 6561 the Square Root.
6561

6561
39366
32805
39366

43046721 Proof.

To *prove* this, and all other *Operations* of this *Kind*, you muſt *multiply* the *Root* found by itſelf, and that *Product* will be the *Square* or *Number* given, if there was no *Remainder*;

*mainder*; but if there was a *Remainder*, then *add* that *Remainder* to this *Product*, and that *Sum*, if the Work has been truly perform'd, will give the original *Number*, as follows,

*What's the Square Root of* 8763827 ?

```
                                  (2960 Root.
          4                         2960
      ------                      ------
   49 ) 476                       177600
      9 ) 441                     26640
      ------                      5920
  586 ) 3538                      ------
      6 ) 3516                    8761600 Product.
      ------                      2227 Remaind.
  592 ) 2227                      ------
      ------                      8763827 Sum.
                                  ------
```

Here you see, after the Work is done, and the other Part of the Root, which is a whole Number, is found to be 2960; the *Remainder* is also found to be 2227, which is a *Numerator* to an indeterminate *Denominator*. For Proof of the Work, the Root 2960 is *squared*, and to that *Product* 8761600, the *Remainder* 2227 is added, and the Sum is 8763827, the given *Number*. Now to find the *Root* neareſt to this *Remainder*, add Pairs of *Cyphers*, and continue the ſame Work, as for the 9 and the 6, thus:

```
                                  (2960,376
5920,3 ) 2227,00,0,0,00,
     3 ) 1776 09
     ------------
5920,67 ) 450 9100
      7 ) 414 4469
     ------------
5920,746 ) 36 463100
       6 ) 35 524476
       -------------
           938624, &c.
```

And ſo you may go on as far as you pleaſe, repeating the ſame Sort of Work continually, for every *Figure* you put in the *Quotient* or *Root*. *Note*, Thoſe *Numbers* that leave a continual *Remainder*, as in the laſt *Example*, are called *Surd Numbers*.

If your given *Number* be a *Decimal* only, you muſt point it as before directed, and then work it in the ſame Manner as if 'twas a whole *Number*; and the *Quotient* or *Root* ſo found or produc'd, will be a *Decimal*, whoſe Value muſt be determin'd by the Value of the *Figures* which compoſe the *Reſolvend*: As,

. . . .

Suppoſe, ,06076225 were given, the *Root* would be ,2465.

Note, *You muſt always count the Number of Places of your given Decimal, and if they are even, Point it as is above directed; but if the Number of Places in your given* Decimal *is* odd, *and is not a* Repetend, *you muſt add a Cypher on the Right-hand to make the Number even:* The Reaſon whereof is very plain, for every *Decimal* being, in reality, but the *Numerator* of a *Vulgar Fraction*, whoſe *Denominator* is *Unity*, with ſo many *Cyphers* added, as are the *Number* of *Figures* in the given *Decimal* or *Numerator*, which *Denominator*, when conſiſting of an odd *Number* of *Figures*, is always a *Square Number*, whoſe *Root* is *Unity*; and as many *Cyphers* as the ſaid *Denominator* conſiſted of *Pairs* of *Cyphers*: As for Inſtance, Suppoſe I was to aſk what is the *Square Root* of ,9, of ,09, of ,009 and of ,0009, the Anſwers would be ,9487 *&c.* for the *Root* of ,9, and ,3 for the *Root* of ,09, and ,09487 *&c.* for the *Root* of ,009, and ,03 for the *Root* of ,0009, *&c.* So that the *Square-Root* of a *Decimal Fraction* always conſiſts of half the Number of Places that the given *Decimal* or *Reſolvend* conſiſts of, and the *Root* of a *Decimal* is always greater in Value than the *Reſolvend* or given *Decimal*; becauſe the *Reſolvend* is to be conſider'd as the *Product*, and the *Root*, as the *Multiplicand* and *Multiplier* of two proper *Fractions*; and all proper *Fractions* decreaſe by *Multiplication*, and increaſe by *Diviſion*. You are to *Note*, that the *Cypher* added to the given *Decimal*, when it conſiſts of an *odd* Number of *Figures*, neither increaſes nor diminiſhes its Value, as has been formerly obſerved, but only increaſes the Number of Places in the *Denominator*, to make it a *Square Number*, viz. *Unity*, and a certain Number of *Pairs* of *Cyphers*.

*If a common Vulgar Fraction be given, to extract the Square Root thereof.*

1. If the given *Terms*, or the *Numerator* and *Denominator* of the given *Fraction*, are *Square Numbers*, *extract* the *Square* of each, and ſet the *Root* of the *Numerator* over the *Root* of the *Denominator*; and the new *Fraction* is the *Root* of the given *Fraction*. As,

*What*

*What is the Square Root of* $\frac{2}{36}$? Anſwer, $\frac{1}{6}$.

2. But if the given *Fraction* cannot exactly have the *Square Root* taken out of the given *Terms*, try if it can be reduced lower, and *extract* the *Root* out of that new reduced *Fraction*, thus:

*What is the Square Root of* $\frac{7}{108}$?

Here, neither the *Numerator*, nor *Denominator*, are *Square Numbers*; therefore I *reduce* this *Fraction* to its loweſt *Terms* $\frac{2}{36}$, and find that the *Root* may then be *extracted*, and is $\frac{1}{6}$, as above.

3. But if the given *Fraction* can neither be reduced lower, nor have the *Square Root* extracted out of both its *Numerator* and *Denominator* (for one of them will not do) then 'tis what is called a *Surd*, and has commonly ſuch a Mark as this $\surd$ ſet againſt it, *viz.*

As, *What is the Square Root of* $\frac{3}{4}$? Anſwer, $\surd\frac{3}{4}$.

But if you are willing to have an *Approximate Square*, reduce the given *Fraction* to a *Decimal*, and *extract* the *Root* of this *Decimal*, ordered, as has been already directed, which may be continued as far as you judge the Nature of the *Matter* or *Buſineſs*, 'tis to be apply'd to, may require, by adding *Pairs* of *Cyphers*, &c. as in this laſt *Example*, tho' 4/the *Denominator* is a *Square Number*, whoſe *Root* is 2, yet 3 the *Numerator* is not a *Square Number*; and therefore the *Fraction* is ſet down thus $\surd\frac{3}{4}$; but when turn'd into a *Decimal*, this $\frac{3}{4}$ becomes ,75, the *Root*, whereof, by the above *Directions*, will be found to be ,866025, *&c.* But if the *Decimal* given, or found, be a ſingle *Repetend*, you muſt make them conſiſt of an even *Number* of *Places*, and take down the ſaid *Repetend* by *Pairs*, and *extract* as before; and if it don't *repeat* at the *ſecond Figure* in the *Root*, 'tis uncertain when it will *repeat*; and ſo you may carry it on to what *Number* of Places you pleaſe, as Occaſion may require.

*Note*, The 1 and 4 are the only ſingle *Repetends*, that have ſingle *Repetends* in their *Roots*, &c. *Compound Repetends* may be *extracted* to any Number of Places you pleaſe, by only extracting half the *Number* deſign'd, and then contract your *Diviſor*, as taught in *Diviſion* of *Decimals*, by which the other Half may be eaſily obtain'd.

*Mr.* WARD'S *Method of extracting the Square Root, is as follows.*

Firſt, *Point* the given *Number* as before, then take or *ſubſtract* the greateſt *Square* out of the firſt *Point* or *Period*,

as

as before, and then *halve* the whole *Remainder*, which *point*, as at *first*, ſo far as to make up the *Figure* of the *Root* already gotten; the true Number at firſt found by pointing, then *divide* this new *Reſolvend* by the *Root* found, and *add* the *Quotient* or *Figure* ſo found, to the other before found; then *multiply* by the laſt *Figure* thus found, and take *half* the *Product* of the firſt *Figure*, and ſet down the firſt *Figure* of this *half*, under the laſt *Figure* of this *Period*, and carry the *Tens*, if any in this half *Product*, to the *Product* of the next *Figure* in the *Diviſor*, and ſo continue till all the *Figures* of the *Root* are gone through. Only *Note*, that if the *Product* or *Square* of the firſt *Figure* is an *odd Number*, then you muſt take down the firſt *Figure* of the next *Period*, to the *Period* already taken down, and ſet the ,5 which is the *Decimal* of the *Half* of the odd *Number*, under it, and *ſubſtract* as in common, as you ſee done in this *Example* following.

. . . . . .

*What is the Square Root of* 572199960721 ( 756439
49

2 | 82199960721 whole Rem.

75 | 4109998036 0,5 new Reſolv.
5 | 3625

756 ) 4849
6 ) 451,8

Anſ. 756439

7564 ) 33198
4 ) 30248

75643 ) 2950036
3 ) 2269245

756439 ) 9807910,5
9 ) 6807910,5

. . . . . Remains.

The ſame *Method* may be uſed with *Decimals* only, or whole *Numbers* and *Decimals* mix'd, *&c.* only in the Caſe of *Repetends* or *interminate Surds*, if you fix your *Number* of *Figures*,

*Figures*, that you are minded to have in the *Root*, you need only *extract* to 1 *Figure* beyond the half *Number* of *Places* assigned to the *Root*, and the rest may be obtained by plain *Division*. As,

*Suppose I would have the Square Root of* 5, *which is a Surd, and would have* 11 *Places of Decimals in the Root, for Exactness.* You may do thus:

```
5 ——— (2,23606 first Part of the Root, found by
4          Extraction and which is the Divisor
-----
1,00, &c. remains.
-----
2,2 ),50, &c. half the Remainder or new Resolvend.
+ 2 ),42
-----------
2,23 ),800
+ 3 ),6645
-----------
2,236 ),13550
+ 6 ),13398
-----------
2,23606 ),1520000
+ 6 ),1341618
-----------
2,23606 ),178382 the Remainder, divided by the above
..... ),156525   Root gives 79775, the latter Part
-----------      of the Root.
  21857
  20125
  -----
   1732
   1565
   ----
    167
    156
    ---
     11
     11
     --
     ..
     --
```

Here being but five *Figures* more wanted, I only *add* the *Result* of the 6th Figure, *viz.* of the 6, to the *Product* of

the 0, as practis'd in the contract Method of *Multiplication of Decimals*, and ſo proceed *pricking off* every time a *Figure*, and at laſt the Quotient is 79775, and the Remainder nothing; ſo that the whole *Root* thus found is 2,2360679775, which is indeed a ſmall inſignificant *Trifle* too much; for if the *Extraction* was to be continued, the true *Root* would be 2,2360679774999, *&c.* with a Remainder.

Enough has been ſaid upon the *extracting* the *Square Root* of a given *Number*, whether *Pure* or *Surd*. We ſhall now go on to the extracting of the

## *CUBE ROOT*,

Which, by the foregoing *Table*, is the 3d *Power* or ſome *Number* twice involved; ſo that if the Numbers 729, 512, 343, 216, 125, 64, 27, 8, or 1, were given, and it was required to extract, or tell what was the *Cube Root* of each of them, the ſaid *Table* will readily inform you, that 9, 8, 7, 6, 5, 4, 3, 2, 1, would be the reſpective *Cube Roots* of the aforeſaid *Numbers*: But if any other *Numbers* greater or leſſer, were given to find the *Cube Root*, then you muſt follow one of the two Methods hereafter ſet down; and firſt we will teach the common Way, which is thus:

Your Number being ſet down, *point the Units Place, and count three Figures towards the Left-hand, if the given Number is a whole Number, and make another Dot, and then count three more*, &c. *till you have counted all; but if it is a Decimal, count three Figures towards the Right-hand, and make a Point*, &c. *as before, in the Square Root, you counted two Figures.*

*What is the* Cube Root *of* 134217728?

Having *pointed* this *Number* as above directed, it will ſtand thus, 134217728, by which it appears there will be three *Figures* in the *Root*, becauſe there are three *Points*; and to know what thoſe Figures are, *I look in the* Table *for the neareſt Cube, that is not more than the firſt Point or Period towards the Left-hand*, viz. 134, *and find it to be* 125, *which I ſet down under the ſaid* 134, *and find the* Root *thereof to be* 5, *which I ſet by itſelf like a* Quotient *or* Diviſor; *then ſubſtracting, the* Remainder *is* 9, *to which I bring down the next Period, and the whole Work will then ſtand thus:*

134217728 (5
125

9217 new Reſolvend. Now

Now to find the two remaining *Figures* of the *Root*, you muſt do as follows, *viz.*

*Square that Part of the* Root *already found*, viz. *the* 5, *and multiply that Square by* 3, *and the Product* 75 *ſet under the new* Reſolvend, *two Places from Unity*; *then triple the* Root *or* 5 *ſo found, and ſet its Product under the* Reſolvend, *one Place from Unity*; *add theſe two Numbers together, and the Total ſhall be a* Diviſor *to this whole* Reſolvend, *with* Unity *omitted*, viz. *to* 921 *inſtead of* 9217; *and here Allowance muſt be made, that this Quotient or ſecond Figure of the* Root *may have or perform the following Operations*, viz. *to multiply the triple Square of the* Root, *and that Product muſt be ſet two Places from the* Units *Place of this* Reſolvend; *then the Product of the Square of the ſaid laſt Figure into the triple of the Root muſt be ſet one Place from* Unity *of this* Reſolvend; *and, laſtly, the* Cube *of the laſt found Figure of the* Root, *muſt be put under the Units Place of this* Reſolvend; *theſe three* Products *or* Sums *added together into one* Sum, *muſt be ſubſtracted from the ſaid* Reſolvend, *and to the* Remainder, *you muſt bring down the next* Period *or* Point, *conſiſting of three Figures, to form another new* Reſolvend, *and then the ſame Work muſt be repeated over again*; *and ſo for every ſingle Figure of the* Root, *till the whole is done, as in the* Example *at large here under.*

134217728 (512 the whole *Root*.
125 the *Cube* of 5 to be *ſubſtracted*.

9217 new *Reſolvend*.

75 the triple *Square* of 5.
15 the *Triple* of the *Root* 5.

765 the *Diviſor* (1 the ſecond Fig. of the Root to be added to the 5, which makes it 51.
75 the *Product* of the triple *Square* of 5 by 1.
15 the *Product* of triple *Root* by the *Square* of 1.
1 the *Cube* of 1, the 2d *Figure* of the *Root*.

7651 the *Subtrahend* or *Total* of the 3 *Lines*.

1566728 the new *Reſolvend.*

7803 the *triple Square* of the whole *Root* 51.
153 the *Triple* of the *Root* 51.

78183 the *Diviſor.* (2 the *Quotient* or 3d *Figure* of the *Root*, which makes it now 512.

15606 the *Product* of the *triple Square* by 2.
612 the *Product* of the *triple Root* by the *Square* of 2.
8 the Cube of 2, the 3d *Figure* of the *Root.*

1566728 the *Subtrahend* or Total of the 3 Lines.

..... the *Remainder.*

After the ſame Manner you muſt proceed for every ſingle *Figure* in the *Root*, if there were ever ſo many, which, when the *Root* conſiſts of many *Figures*, makes the Work very tedious and troubleſome. In this *Example*, the *Number* given is a pure or exact *Cube*, and ſo here is no *Remainder*; but had it been but a Unit leſs, the *Remainder* would have been large; but if the given *Number* had been more, the *Remainder* would only have been ſo much as it was more, till it riſe ſo high as to make the 2, or laſt *Figure* in the Root, a 3, 4, *&c.* in which Caſe of *Remainders*, if they are any thing ſignificant, you muſt add *Triplets* of *Cyphers*, viz. 000, each time; and then continue the above Work for every Place of *Decimals* you ſhall think fit to have in your Root.

If your *Number* given was only a *Decimal*, you muſt begin to Point from the *Left-hand* towards the *Right*; and if there are not *Figures* enough, make them up with *Cyphers*, and then work in every reſpect as before; but if the given *Number* conſiſts of Part whole *Numbers*, and Part *Decimals*, point the whole *Numbers* as before, and the *Decimals* as above. As ſeveral *Methods* have been made uſe of to facilitate this Sort of Proceeding, take what follows from Mr. *Ward*, Page 131, of his *Mathematician's Guide.*

After having pointed the given *Number*, as before directed, find by the *Table*, the neareſt *Cube* to the firſt *Point*, whether it be *greater* or *leſſer* than the ſaid given *Point.*

If the *Cube* ſo found be *greater* than the firſt *Point* or *Period* of the *Reſolvend*; then the *Root* or *Figure* ſo found, is greater than it ought to be: And therefore you muſt ſet down, or imagine a ſufficient Number of *Cyphers* to be added

added to it, and then ſubſtract the whole Reſolvend from the ſaid *Root* and *Cyphers*; but if the *Cube* found in the *Table* be leſs than the firſt *Point* of the *Reſolvend*, ſubſtract it from the ſaid firſt *Point* or *Period*; then to the firſt *Figure* of the *Root* thus found, whether its *Cube* be *bigger* or *leſſer* than the firſt *Point* or *Period* given, *add* as many *Cyphers* as there are *Dots* or *Points* remaining in the *Reſolvend*; *multiply* theſe by 3, and make the *Product* ariſing a *Diviſor*, by which divide the *Difference* between the *Cube* and the *Reſolvend*, as found above; and the *Quotient* will depreſs the ſaid *Remainder* or *Difference* to a *Square*, and muſt be accordingly *pointed a-new*, as a *Square*, beginning at *Unity*, and making a Point at every two *Figures*, till you have made as many as you added *Cyphers* to the *Root*, to form your ſaid *Diviſor*: This done, make the *Figure* of the Root already found, a *Diviſor* to the firſt *Point* or *Period* of the new *Reſolvend*, as you do in the *Square Root*; only you muſt obſerve, that if the *Cube* of the ſaid *Figure* or *Diviſor* was leſs than the firſt *Point* or *Period*, you muſt annex the *Quotient Figure*, or ſecond *Figure* of the *Root* to it; and then *multiply* the *Diviſor*, ſo increaſed by the ſaid *Quotient Figure*, ſetting down the *Units* Place of the *Product*, under the pointed *Figure* of this *Period*, &c. as in the *Square Root*; then *ſubſtract* and bring down the next *Point* or *Period*, and proceed in the ſame Manner till all is done. But if the *Cube* of the ſaid firſt *Figure* of the *Root* be greater than the firſt *Period* of the given *Reſolvend*; then you muſt *ſubſtract* the *Quotient Figure* from a *Cypher*, annexed, or ſuppoſed to be annexed to the ſaid firſt *Figure* of the *Root* or *Diviſor* on the *Right-hand*, and *multiply* the *Remainder* by the *Quotient Figure*, and *ſubſtract* this *Product* from that Part of the new *Reſolvend*, as was brought down for this ſecond *Figure* of the *Root*, and ſo proceed for every *Point* or *Period*, till all is done. For *Example*, Let us take 134217728, the *Number* we had before, Page 353 and 125, will be the neareſt *Cube* to 134, the firſt *Period*, and is leſs than the ſaid firſt *Point*, and has 5 for its *Root*.

134217728
125

*Divisor* 15,00) 92177,28 the *Dividend.*
90 (6145,152 *Quotient.*

21
15

67
60

77
75

22
15

78
75

30
30

..

. . . .

5 ) 6145,1520 — (512 Root.
+1) 51

51 ) 1045
+2) 1024

21,15, *&c.* Remainder to be rejected.

Here, after you have found the *Root*, to as many Places as there are Points, in the given *Resolvend*, try it, that is, cube the Root thus found, and if it comes right, your Work is done; but if not, then every thing here done must be repeated, only instead of using the first single Figure, 5, you must use the whole 512; and this is called a second *Operation*, and would

have increaſed the laſt *Root* to *nine Places*; becauſe by this Method, every *Operation* triples the foregoing Number of *Figures* that were found in the *Root*, by the former *Proceſs*. Only you muſt *Note*, that when the *Cube* of the *Root* found, comes ſo near the given *Period*, that the ſecond *Figure* of the *Root* will be a *Cypher*, then 'twill be neceſſary to continue the firſt Work, till there comes out 4 or 5 Figures in the firſt *Root*.

## *EXAMPLE* II.

65228104372 (4000 leſs.
64 (3 / 12000 Diviſor.

12,000) 1228104,372 Dividend.

402 ) 102342,03 (4025,4
2 ) 804

4025 ) 21942
5 ) 20125

4025,4 ) 1817,03
4 ) 1610,16

206,87 Remains.

Here the *Root* is ſomething too ſmall, for when *involved* to the 3d *Power*, the Reſult is 65226958307,064; but if more Exactneſs was required, a ſecond *Operation* would give you a ſufficient Number of *Decimal Places* to make it exact. The *Method* of theſe ſecond *Operations* you may ſee by the following *Example*.

*What is the* Cube Root *of*

. . . . . .

70537960298907396027963029889 0 ?
729000000000000000000000000000 Cube of 900, *&c.*

2362039701092603972036970111 0 the Remainder, which is alſo the *Dividend*, and 27000000000 is the *Diviſor*, and 8748295189231866 56 will be the Quotient and new Reſolvend, depreſſed to a Square.

1 *Diviſor*

1 *Diviſor* 90. )87482951892318665 6 New Reſolvend.
9 )8019 (900000000
,09819

2 Ditto 891. )72929
8 )71216 8901810000

3 Ditto 8902. 171351 8901800000
1 89019 3

4 Ditto 89019. 8233289 26705400000 new
9 80111629 *Diviſ.*

5 Ditto 890181

For the firſt Part of this Work, only 5 *Figures* are taken, *viz.* 89018, the other 5 are for the preſent ſupply'd with *Cyphers*, which makes it 8901800000, which raiſed to the 3d *Power* or *Cubed*, is

705396820513832000000000000000

from which

*Subſtract* 705379602989073960279630298890 given *Reſ.*

26705400000)re.1721752475803972036970111 0 for a new *Divid.*

89018. )644720721578397 new Reſolvend and Quotient.
7

890173. 6231211 | (72426,45
2 )

8901728. 21599621 | 8901800000 *Root* before.
4 17803456 | 72426,45 *Root* now found

89017276. 3796165 | 57 | 8901727573,55 *Root* required.
2 3560691 | 04

890172758. 235474 | 5383
6 178034 | 5516

8901727574. 57439 | 986797
,4 53400 | 365444

8901727573,6. 4039 | 62135300
05 3560 | 69102944

8901727573,55 478 | 9303235600
445 | 0863786775

But

But you might have contracted the Work, at the 3d Step of this laſt Work, as in contract *Diviſion* of *Decimals*, and ſo have omitted all the Figures on the Right-hand of the perpendicular Line; and though there may ſeem much Work here, yet if it was proſecuted by the firſt Method, 'twould have been near fifty Times as much Labour and Trouble.

The Proof of theſe *Operations*, is by involving the Roots thus found to the third *Power*, or what is commonly called *Cubing* the *Roots*. There is ſeldom Occaſion for extracting the *Roots* of *higher Powers*, ſuch as the 4, 5, 6, 7, 8th, *&c.* in common *Arithmetick*; only you may *Note*, that the fourth *Power* may be *extracted*, by firſt *extracting* the *Square Root* of the whole *Reſolvend*; and then *extracting* the *Square Root* of this firſt *Root*, and this ſecond *Square Root* will be the *Biquadrate Root* ſought.

We ſhall now go on to treat of *Intereſt*, both *Simple* and *Compound*; and here, as in moſt other Parts of *Arithmetick*, *Decimals* may be exceeding uſefully applied. And firſt, in

## *SIMPLE INTEREST*,

That is, where no other Conſideration is had, but the bare *Money* allow'd for the *Uſe* of a *Sum*, borrowed of another, for a certain *Time*. Now this is uſually at ſome determinate *Rate*, for *one hundred Pounds*, for *one Year*. This formerly was very high, as L. 10, 9, 8, *&c.* and now is ſometimes 3, 4 or 5, and beyond L. 5. no Perſon can *legally* take; and therefore we will ſhew the beſt and eaſieſt *Methods* of doing the ſaid latter *Rates*, for any *Sum* greater or leſſer than a L. 100. and for any Time greater or leſſer than a *Year*. And,

Firſt, you are to *Note*, that the *Sum lent*, or *borrowed*, be it little or much, is called the *Principal*. *Secondly*, That the *Money* agreed to be paid for the *Uſe* of L. 100, for one *Year*, is called the *Rate*; but if no Agreement is made, then the *Sum* borrowed always pays the moſt that the *Law* allows, which at this Time is L. 5 per *Cent.* per *Annum*; but if a leſs *Sum* is agreed for to be the *Intereſt*, 'tis always expreſſed in the *Bond*, *Note*, *Deed*, or other *Covenant*. And here you are to obſerve, that no *Covenant* is *legal*, where the *Intereſt* is charged higher than L. 5 per *Cent.* per *Annum*, though you may make it for as much leſs as you pleaſe.

*EX-*

## *EXAMPLES.*

*What is the Intereſt of* L. 2175 : 16 *for a Year, at* 3, 4 *and* 5 *per* Cent?

The common *Method* of doing theſe Queſtions, is this that follows.

| | | |
|---|---|---|
| L. 21 | 75 : | 16 |
| | | 5 |
| 108 | 79 : | — |
| | | 20 |
| 15 | 80 | |
| | | 12 |
| 9 | 60 | |
| | | 4 |
| 2 | 40 | |

Here 'tis underſtood, that this Queſtion is thus ſtated: If L. 100 *gains* L. 5, *What will* L. 2175 : 16 *gain?* And to ſave Trouble, the whole is multiply'd by 5, and divided by 100; and then the Remainder is 79, which are $\frac{79}{100}$ of a L. whoſe Value is found, as formerly directed; but Decimally the Work is much ſhortned, thus

| | |
|---|---|
| | L. 2175,8 |
| | 5 |
| | 108,79,0 |

where the Anſwer is L. 108,79, or L. 108,15 : 9$\frac{1}{2}$. The like for any other Rate, as for L. 3 L. 4, &c. per *Cent.* per *Annum.*

| | | |
|---|---|---|
| L. 21 | 75 : | 16 |
| | | 4 |
| 87 | 03 : | 4 |
| | | 20 |
| 0 | 64 | |
| | | 12 |
| 7 | 68 | |
| | | 4 |
| 2 | 72 | |

Anſ. L. 87 : 00 : 7$\frac{1}{2}$

| | | |
|---|---|---|
| L. 21 | 75 : | 16 |
| | | 3 |
| 65 | 27 : | 8 |
| | | 20 |
| 5 | 48 | |
| | | 12 |
| 5 | 76 | |
| | | 4 |
| 3 | 04 | |

Anſ. L. 65 : 5 : 5

*Decimally*

*Decimally* thus:

L. 2175,8 the *Principal.*
4 *per Cent. per Ann.* Intereſt.

L. 87,03,2, Or L. 87 : — : 7 ¼ *Total* Intereſt.

L. 2175,8 the *Principal.*
3 *per Cent. per Ann.* Intereſt.

L. 65,27,4, Or L. 65 : 5 : 5 ¼ *Total* Intereſt.

By the foregoing *Examples*, you may find what the *Intereſt* of any *Sum* of *Money* will amount to for a *Year*, but if the *Time* be greater or leſſer than a *Year*, ſay, *As one Year is to the Intereſt of the Sum given for that Time; ſo is the Time requir'd, to the Amount of the ſame Sum, at the ſame Rate for that Time.* As for Example:

*What comes the Intereſt of a Bond to for* L. 359 : 15 : 6, *from the* 15*th of* January 1735, *to the* 6*th of* June 1738, *at* 5 *per* Cent. *per* Annum?

Firſt find the *Intereſt* for *one Year*, as before, thus:

359,775
5

L. 17,98875, or L. 17 : 19 : 9 ½

Then conſider how much the whole *Time* is, *viz.* 2 Years 142 Days; then by the *Rule* above, ſay,

*Years. Days.*
*As* 1 *Year is to* 17,98875, ſo is 2 : 142

To 42,976, or L. 42 : 19 : 6 ¼
To which *add* the *Principal* L. 359 : 15 : 6

And the whole Amount is L. 402 : 15 : 0 ¼

Or you might *multiply* the *Quotient* of the *Rate* divided by 100 by the *Time*, and part off that *Product* by a *Comma*, and *add* an *Unit* on the *Left-hand* of the ſaid *Comma*,

and then that whole *Sum*, *multiply'd* by the *Principal*, will give you the Amount of the Principal and Intereſt.

The *Quotient* of the *Rate* of the laſt *Example* is,

,05 this multiply'd
by - - - 2,389 the whole *Time*,

gives - - ,11945

to which add *Unity* and the *Sum* is 1,11945, this *multiply'd* by - - - - 359,775 the *Principal*, gives L. 402,75, or L. 402,15 for the *Sum* of the *Principal* and *Intereſt*.

Both theſe Ways may be uſefully apply'd to the common Publick Bonds, ſuch as the *South-Sea* Company's, the *India* Company's, *&c.* For if you are to receive only the *Intereſt*, you may uſe the firſt Method; but if you ſell or buy a *Bond*, you may uſe the laſt *Method*.

## *EXAMPLE.*

*What muſt I give for an* India Bond, *Value* L. 500, *Intereſt at* L. 3½ *per* Cent. *per* Annum, Prem. *L.* 6 : 10 *per* Cent. *Intereſt due upon the ſaid Bond, from the* 30*th of* September, 1737, *to the* 6*th of* June 1738?

249 Days, or ,6822 the *Time*,
multiply'd by ,035 the *Rate*,

gives 1,0238770 for *Prod.* with *Unity* added, which multip. by the real *Prin.* 500

gives L. 511,9385, or L. 511 : 18 : 9¼ the *Sum* of the *Principal* and *Intereſt*; to which *add* the *Premium* upon the Whole - - 32 : 10

and the Total Amount L. 544 : 18 : 9¼ is the *Sum* of the *Principal*, *Intereſt* and *Premium*, or the *Sum* that is to be paid for the ſaid *Bond*, upon the above Conditions.

Or thus:
L. 500 the *Principal*.
3,5 the *Rate*.

17,500 the *Intereſt* 1 Year.

*Then*

*Then you may ſay,*

As 1 Year to L. 17,5, ſo is 249 Days to

L. 11 : 18 : 9 ¼ for *Intereſt*; to which
add L. 532 : 10 the *Sum* of the *Prem.* and *Prin.*

and the Total 544 : 8 : 9 ¼ is the preſent Value of the *Bond.*

The like may be done for any other *Sum* or *Time*, bigger or leſſer, at the ſame or any other *Rate* of *Premium* and *Intereſt*, where you are to *Note*, that the *Intereſt* is never to be reckoned upon the *Premium*, but upon the *Principal* only, becauſe all *Premiums* are ſubject to many and great *Variations*, according as the Humour of the People is, or according to the Plenty or Scarcity of *Money*, or the Situation of publick *Credit*. Now the *Intereſt* of theſe Sort of *Bonds* are generally calculated by *Tables* ready caſt up, at the *Rates* the *Bonds* are made for, and which in common Practice are ſufficiently *exact*; and the Method of doing it is thus:

Count how many whole *Months* and *Days* are elaps'd from the Time of diſcharging the laſt *Intereſt*; as in the *Example* before us, 'tis 8 *Months* and 6 *Days*.

| | | | |
|---|---|---|---|
| The *Intereſt* of L. 500 for 8 *Months* is | L. 11 | : 13 | : 4 |
| for 6 *Days* | — | : 5 | : 9 |
| Total is | L. 11 | : 19 | : 1 |
| Intereſt found above, is | 11 | : 18 | : 9 ¼ |
| Difference is | — | : — | : 3 ¼ |

The Reaſon whereof is, that the *Tables* reckon 1 *Month* to be the $\frac{1}{12}$ Part of a *Year*, and conſequently, that 8 *Months* and 6 *Days* is 249 *Days* and ¼; but the real Time is but 249 *Days* abſolutely; ſo that in ſuch a like Caſe, the *Tables* reckon the *Intereſt* of L. 500 for ¼ of a *Day* too much, which is 3d ¼ exactly, as the Difference above ſhews it to be, and which is an infallible Proof, both of the Truth of the above *Arithmetical Calculations*, and of the Correctneſs of the *Tabular Calculation*. The *Tables* here mention'd, are calculated by myſelf, and are to be had of Mr. *Ware*, the *Proprietor* of this *Book*, called, *Tables*, ſhewing by *Inſpection*, the

*Intereſt* of any *Number* of *Pounds*, from *one progreſſively* to *one Hundred*, &c. at the ſeveral *Rates* of, 3, 3½, 4 and 5 per *Cent.* with *Directions* to make them *applicable* to all manner of *Sums* and *Rates*, and for any *Time*, which, to thoſe who have not Leiſure or Skill ſufficient to make uſe of the *Methods* here taught, is a very great Advantage; and for thoſe that have, may ſerve as a *Proof* of the Truth of their *Work*: And as *odd Time* is very frequent, eſpecially in *Publick Bonds*, therefore the following *Table* will be of Uſe for the ready finding the Number of Days between any given Times of the Year.

| | | | | |
|---|---|---|---|---|
| 31 | 334 | January | 00 | 31 |
| 59 | 306 | February | 31 | 28 |
| 90 | 275 | March | 59 | 31 |
| 120 | 245 | April | 90 | 30 |
| 151 | 214 | May | 120 | 31 |
| 181 | 184 | June | 151 | 30 |
| 212 | 153 | July | 181 | 31 |
| 243 | 122 | Auguſt | 212 | 31 |
| 273 | 92 | September | 243 | 30 |
| 304 | 61 | October | 273 | 31 |
| 334 | 31 | November | 304 | 30 |
| 365 | 00 | December | 334 | 31 |

## *EXPLANATION.*

The *middle Column* contains the Names of the ſeveral *Months* of the *Year*; the outſide Column on the *Right-hand*, ſhews the Number of *Days* that are in each *Month*; and the inſide *Column*, immediately joining to it, ſhews the Number of *Days* it is from the firſt *Day* of *January* to the firſt *Day* of each of the other *Months* reſpectively: As for *Example*, from the firſt *Day* of *January*, to the firſt *Day* of *February*, is 31 *Days*; and from the firſt *Day* of *January*, to the firſt *Day* of *July*, is 181 *Days*; and ſo of any other; as from the firſt of *January* to the firſt of *May* is 120 *Days*; and to the firſt of *November*, 'tis 304 *Days*, &c. the furthermoſt *Column* on the *Left-hand*, ſhews the *Number* of *Days* that is in the ſeveral *Months* of the *Year*, beginning with the firſt of *Jan.* as, to the End of *April*, is 120 *Days*; to the End of *Auguſt*, is 243 *Days*; and to the End of *December*, is 365 *Days*, &c. The next *Column* adjoining, ſhews how many *Days* there

are in all Months of the Year, below that againſt which the Name is wrote. As, from the laſt Day of *February*, to the laſt Day of *December*, is 306 Days; ſo from the laſt of *Auguſt*, is 122 Days, *&c.*

*The Uſe of the foregoing Table,*

Is, to find how many *Days* 'tis from any one Part of the *Year* to any *other*. As, ſuppoſe I aſk, *How many Days 'tis from the 3d of* Auguſt *to the 17th of* January *following?* Here you are to *Note*, that if the laſt Month mentioned, goes beyond the End of *December*, that you muſt firſt look in the inward *Left-hand Column*, for the firſt *Month* mentioned: As, in this *Queſtion* for *Auguſt*, againſt which is ſet 122 under this ſet the Complement of the Days in that *Month*, viz. - - - - 28
then go to the inward Column on the Right-hand, 17
and ſet down what is ſet againſt that *Month*, which —— here being *January*, is 00; and then add the Num- 167
ber of *Days* in the *Month*, which in this *Queſtion* is 17; ——
the *Sum* of all theſe is the Number of Days ſought, which in this *Queſtion* is 167, as may be eaſily proved thus:

28 Days in *Auguſt*.
30 *September*
31 *October*
30 *November*
31 *December*
17 *January*

167 Total.

But if the *Queſtion* is for any *Time* within the firſt of *January* and 31 *December*, do thus: *Look out the Month that is moſt diſtant from* January, *in the* Queſtion, *and ſet down the Number that ſtands againſt it, in the inſide Right-hand Column, and add to it the Days given, if any; under this Sum, ſet the Sum of the neareſt Month and Days to* January, *and ſubſtract the one from the other, and the Difference or Remainder will be the Number of Days ſought.*

*EXAMPLE.*

What Number of Days are there between the 7th of *February* and the 15th of *Auguſt?*

31 Days againſt *February*.
7 Days in *February*.

38 Days to 7 *February*.

| | | | |
|---|---|---|---|
| 21 | Days in *Feb.* | 212 | againſt *Auguſt.* |
| 31 | *March* | 15 | *Days* in *Auguſt.* |
| 30 | *April,* | Proof. | |
| 31 | *May* | Total 227 | the *Days* to 15 *Aug.* |
| 30 | *June* | 38 | Days to 7 *Feb.* |
| 31 | *July* | | |
| 15 | *Auguſt* | Rem. 189 | is the *Days* from 7 *Feb.* to 15 *Aug.* |
| 189 | | | |

From what has been already ſaid, enough relating to the *Practice* of this *Rule*, may be learnt, to know the Amount of any *Sum* at any *Rate*, for any *Time*; but as ſome *Queſtions*, more curious than needful, may be propos'd, and require from other *Data*, other *Things*, I will juſt hint one or two to you, and the reſt will follow; as,

*In what Time will L.* 2500 *come to L.* 3000, *at* 5 *per* Cent. *per* Annum, *ſimple Intereſt?*

Here 'tis very plain, that the *Intereſt Money* is L. 500, therefore find what the Amount is for one Year thus:

2500
5
L. 125 | 00

Then ſay, *If L.* 125, *require* 1 *Year*, *What will L.* 500 *require?* Anſwer, 4 *Years.*

Or more univerſally thus: *Subſtract the Principal from the whole Amount, and divide the Difference or Remainder, which is the whole Intereſt, by the Product of the Principal and Rate divided by* 100, *and the Quotient will be the Time ſought.*

*The* Example *above over again.*

L. 3000 the whole *Amount* of *Principal* and *Intereſt.*
2500 the *Principal* only to be *ſubſtracted.*

500 the *Difference* or *Intereſt* which is to be the *Divid.*

2500

2500 the *Principal.*
5 the *Rate.*

12500 This *Product* divided by 100 is 125, which is to be the *Diviſor* to 500 the above *Dividend.*

125 | 500 (4 the *Quotient*, which are whole *Years*, becauſe
500 (L. 125 was the *Amount* for 1 *Year*; but if there had been any *Remainder*, continue dividing by bringing down Cyphers, till you have as many Decimal Places as will, with ſufficient Exactneſs, expreſs the Parts of a *Year.* As,

*How long Time will L.* 300 *be in amounting to L.* 400 Simple Intereſt *at* 3 ½ *per* Cent?

3 00
3,5

10,5 | 00 (100,— (9,523809
945 365

550 191|18700 Product.
525

250
210

400
315

850
840

10

*Anſwer*, 9 Years and 191 Days 4 Hours 34 Minutes.

Or you may *multiply* the firſt *Remainder*, after the *Years* are found, by 365, and divide by 10,5, and the *Quotient* will be the ſame as above.

5,5 *Remains.*
365

10,5)2007,5 *Product.*

20 Remains, and the *Quotient* is 191 *Days.*

And

And if you are minded to have greater Exactneſs, both will produce 4 Hours and 34 Minutes.

Or, Suppoſe I put the Queſtion thus:

*What Rate of* Simple Intereſt *in four Years, will make* L. 2500 *amount to* L. 3000?

Say, *If* 4 *Years give* L. 500, *What will* 1 *Year give?*

Anſwer, L. 125.

Then, *If* L. 2500 *give* L. 125, *What will* L. 100 *give?*

Anſwer, L. 5.

*Or more univerſally thus:*

*Divide* the whole *Intereſt* by the *Product* of the *Principal* and *Time*, and the *Quotient* gives the *Rate* divided by 100.

Thus, 2500 the Principal.
4 Years the whole Time.

*Prod.* 10000 the *Diviſor* to L. 500 the *Intereſt*; the *Quotient* is ,05; this *multiply'd* by 100 gives L. 5 per *Cent.* for the *Rate*. So that now any thing relating to this *Branch* of *Intereſt* may be eaſily anſwered. But there are other *Buſineſſes* relating to this Head, not yet ſufficiently explain'd, *viz.* the calculating *Commiſſions*, and *Brokage* for *Sales* of *Goods*, &c. *Diſcompts* for prompt Payments, *Premiums* for *Inſurance*, *Penſions*, *Annuities*, &c. As,

*What comes the Inſurance of* L. 7,85 *to at* L. 1 $\frac{1}{4}$ *per Cent?*

1,9625

Anſwer, L. 9,8125 Or, L. 9 : 16 : 3

Or, by the Vulgar Method thus:

| | |
|---|---|
| Thus, L. 7 \| 85 | L. 7 : 17 : for 1 per *Cent.* |
| 20 | 1 : 19 : 3 for $\frac{1}{4}$ per *Cent.* |
| 17 \| 00 | L. 9 : 16 : 3 |

*What*

*What comes the Commission of* L. 594 : 13 *to at* 2½ *per Cent?*

2

Vulgarly thus, 11 | 89 : 6
20

L. 11 : 17 : 10¼ 22/100 for 2 *p.Ct.* 17 | 86
10*s.* is¼ 2 : 19 : 5½ 11/100 for 10*s. p. Ct.* | 12
of L.2
Tot. L.14 : 17 : 3¼ 33/100 at L.2½ *p.C.* 10 | 32
4

1 | 28

Decimally thus: L. 594,65
2,5

297325
118930.

L. 14,86625 Or L. 14 : 17 : 3¼.

*Suppose I am to be allow'd* L. 6 *per* Cent. *Discount, for prompt Payment, What must I pay for* 5 *Bales of Silk, that by weight comes to* L. 730? Ans. L. 686 : 4.

Now all such Questions as these may be answer'd either by finding the *Amount* of the Whole, as if it was for the Interest of 1 Year, as above, and *substracting* that from the whole *Sum*, and the *Remainder* will be the *Sum* to be paid; or else, by *substracting* the *Allowance* from 100, and *multiplying* the whole *Sum* by the *Remainder*, and *dividing* that *Product* by 100, the *Quotient* will be the *Answer* sought. As in the following *Example*.

*The first Way.*

730 the whole *Sum*.
6 *per* Cent. allowed for Discompt.

L. 43,80 Or L. 43 : 16, the whole *Discompt*, which *substracted* from L. 730 leaves L. 686 : 4, the Nett *Sum* to be paid.

*The ſecond Way:*

Or, 730 the whole Sum
multiply'd by 94 the Difference between 100 and 6.

2920
6570

gives 68620 for the *Product* to be *divided* by 100, and then the *Quotient* will be L. 686,20, Or L. 686 : 4, as above.

You muſt *Note*, that in *Commiſſions*, *Brokage*, *Diſcompts* upon *Goods* and *Inſurances*, there is no Regard had to *Time*, or you may always conſider them as done for *one whole Year*.

For the more eaſy performing every *Operation*, 'twill be proper to find, at the ſeveral *Rates*, the *Amount* of L. 1 only, and then multiply *Decimally*, and the *Products* will have nothing to be done to them, but to be valued, as has been taught in *Multiplication* of *Decimals*, &c. As for Inſtance, the above *Sum* 730, *multiply'd* by ,06 gives 43,80 for the *Product*; and ſo of all others. It will likewiſe be very uſeful to find in *Decimals*, what the *Amount* of L. 1 for 1 *Day*, is at the ſeveral *Rates* commonly made uſe of in *Bonds*. Thus the *Intereſt* of L. 1 for 1 *Day*, at 5 *per* Cent. is ,000137; at 4 *per* Cent. ,0001096; at 3 *per* Cent. ,0000822; at 2 ½ *per* Cent. ,0000685; at 3 ½ *per* Cent. ,0000956 17, *&c.* by which any common Buſineſs may eaſily be done: Thus, What comes the *Intereſt* of 5 *Bonds* each L. 100 to, at 4 *per* Cent. for 17 *Days*?

Here you may *multiply* L. 500 the whole Principal by 17 and ,0001096, or by ,0001096, and 17, which you pleaſe, and the *Product* will be the *Anſwer* ſought.

Thus, 500
17

8500
,0001096

548000
8768

Anſwer, ,9316000, or 18 *s.* 7 *d.* ½

As

As may be found either by the Methods before taught, or by the Tables before mentioned. So if it was required to find the Amount for 3, $3\frac{1}{2}$, or 5 *per* Cent. of the ſaid Sum, for the ſaid Time, the reſpective Work and Anſwers will be as follows,

| | | Or, | |
|---|---|---|---|
| 500 | | 500 | |
| 17 | | 17 | |
| 8500 | | 8500 | |
| ,0000822 | | 9589 | |
| 411000 | | 4794500 | |
| 6576 | | 76712 | |
| ,698700 | | ,81506500 | |
| Or, L. 00 : 13 : 11 $\frac{1}{2}$ for 3 *per* Cent. | | Or, L. 00 : 16 : 3 $\frac{1}{2}$ for three $\frac{1}{2}$ *per* Cent. | |

500
17
8500
,000137
68500
1,096
1,164500

Or, L. 1 : 3 : 3 $\frac{1}{2}$ for five *per* Cent.

All which Anſwers exactly agree with the before mentioned Tables.

Once more: *What is the Intereſt of* L. 875 : 13 : 6 *for* 85 *Days, at* 3, $3\frac{1}{2}$, 4 *and* 5 *per* Cent.

In all ſuch Caſes, where you have odd *Money*, if it amounts to more than 10 *s.* (for the ſake of Eaſe in working) ſet down a *Pound*, and if under 10 *s.* reject it; for if the *Time* be not very long, the Difference will be very little, eſpecially if the *Rate* of *Intereſt* be low, as appears from the following *Examples*.

L. 876 instead of L. 875 : 13 : 6.
85 Days.

4380
7008

L. 74460 for one Day.
,0000822 fix'd Number at 3 *per* Cent.

148920
148920
595680

L. 6,1206120, Or *L.* 6 : 2 : 4 ¼.

L. 875,675 Or, L. 875 : 13 : 6.
85 Days.

4378375
7005400

L. 74432,375 for one Day.
,0000822 fix'd Numb. at 3 *p. C.*

148864750
148864750
595459000

6,1183412250, Or *L.* 6 : 2 : 4 ¼

Here the *Difference* is but an *Half-penny*, in 85 Days, tho' you reckon the Sum 6*s.* 6*d.* too much, to save the Work.

*L.* 876

*L.* 876 at 3 ½ *per Cent.*
85 Days.

4380
7008

*L.*74460 for one Day.
,00009589 the fix'd Number for 3 ½ *per Cent.*

670140
595680.
372300..
670140...

7,13996940, Or *L.* 7 : 2 : 9 ½.

*L.* 875,675 at 3 ½ *per Cent.*
85 Days.

4378 375
70054 00

*L.*74432,375 for one Day.
,00009589 the fix'd Numb. for 3 ½ *p. C.*

669891375
595459000
372161875
669891375

L. 7,13732043875, Or *L.* 7 : 2 : 9.

The like may be done for any other *Rates*, *Times*, or *Sums*, where the Difference in common Practice is insignificant; and therefore I shall now conclude this Head, and say a Word or two about

## *REBATE* or *DISCOMPT*,

That is, what present *Sum* of *Money* must be paid for any *Sum* due, or to be paid, some Time hence, allowing *Discompt*, after the *Rate* agreed upon, at *Simple Interest*.

*EX-*

## *EXAMPLE.*

*Suppoſe a Year hence I was to pay a Legacy, a Year's Rent for a Farm,* &c. *and the Money was to be L.* 450, *but the Party to whom 'twould then be due, deſires to have it immediately, and would therefore allow Diſcompt at* 4 *per Cent. per Annum,* Simple Intereſt.

## *OBSERVATION.*

By the very Conditions of this *Queſtion*, 'tis evident that juſt ſo much *preſent Money* muſt be paid for the above *L.* 450, that when put out at *Intereſt*, at *L.* 4 *per Cent.* the *Sum* of the *Principal* and *Intereſt* muſt make up the ſaid *Sum* of *L.* 450; and therefore the common Methods of diſcounting *Sums* of *Money*, where *Time* is concerned, is wrong, becauſe the whole *Sum* is not *diſcompted*: Therefore to find the true *Sum*, you muſt find the *Intereſt* of *L.* 1, or *L.* 100, *&c.* at the given *Rate*, for the given *Time*, and then ſay, As that aſſum'd *Principal* and *Intereſt*, is to the *Principal*, ſo is the given *Sum* to the *Sum* ſought. As here the *Intereſt* of *L.* 100 for 1 Year, is *L.* 4, the *Sum* is 104; therefore I ſay,

As *L.* 104 is to *L.* 100, ſo is *L.* 450 to *L.* 432 : 6923, or *L.* 432 : 13 : 10.

Here the *Anſwer* is *L.* 432 : 13 : 10, to be paid immediately; ſo that *L.* 17 : 6 : 2 is allowed for the *Intereſt*: And that we may be ſure whether the *Work* is *right*, let us ſee what the *Intereſt* of *L.* 432,6923 comes to, for 1 Year, at 4 *per* Cent.

4

*Viz.* *L.* 17,307792 Or, L. 17 : 6 : 2.

Now, *L.* 450 is the whole Money due one Year hence.
*L.* 432 : 6923 is the preſent Money found.

And *L.* 17,3077 is the *Premium* or *Diſcompt*, which is exactly the ſame with the *Intereſt* of *L.* 432 : 13 : 10; as plainly appears by the Work before you.

But the common *Method* is to find the *Intereſt* of the whole *Money*, and *ſubſtract* that from the whole *Money*, and to call the *Remainder* the *Sum* or *Money* to be paid down:

Thus

Thus, *L.* 450 the *Principal.*
4

*L.* 18,00 the *Intereſt* for one *Year.*

*L.* 432 the *Sum* to be now paid, which is *L.*0 : 13 : 10 too little; and if the *Time* was *longer*, or the *Sum* or *Rate* greater, the *Error* would be alſo proportionally larger; but in ſmall *Sums* for ſhort *Dates*, the *Difference* is inconſiderable; and as plain *Intereſt* is much eaſier to work than Diſcompt, it may be ſafely enough uſed. As for

*EXAMPLE.*

*Suppoſe I have a Bill of Exchange, that wants fourteen Days of being due, What Diſcompt muſt I allow at L. 5 per* Cent. *per* Annum, *if the Bill is drawn for L.* 133 : 10? Anſwer, 5 *s.* 01 *d.* ½, Or L. 133 : 4 : 10 ½ ready *Money.*

For L. 133,5 *Principal.*
at 5 *per Cent.* Intereſt.

gives L. 6,675 *Intereſt*, for 1 Year.

Then if 365 *Days*, or 1 *Year*, gives L. 6,675, *What will* 14 *Days* give? Anſwer, L.00 : 5 : 1 ½; this ſubſtracted from the whole *Sum*, leaves L. 133 : 4 : 10 ½ for the ready *Money:* And by *Diſcompt*,

Say, *As* L. 365 *Days is to* L. 5, *ſo is* 14 *Days to* ,1919, *&c.*

Then, as 100,1919 is to L. 100, ſo is L. 133,5 to L. 133,244 the preſent *Money* to be paid: Or, L. 133 : 4 : 10 ¼.

So that the Difference in this *Sum* is too inſignificant to want any change of Method, though 'tis abſolutely certain that in larger *Sums*, and longer *Time*, 'tis worth while to follow the other Method, as you have ſeen above. We ſhall now touch upon

*ANNUITIES* at *Simple Intereſt.*

The Meaning of this is, that I am ſuppos'd to buy a *Yearly*, half Yearly, or Quarterly Income, to continue ſome time to come, and am to diſcompt *Simple Intereſt* at 3, 4, 5, *&c.* per *Cent.* per *Annum*, and to pay the *Money* now immediately; or I am to pay off the whole *Rent* of my *Houſe* for a *Term* of *Years* to come, or a Part of my *Rent*,

which is the Caſe of all *Fines*, &c. Or I may be ſuppos'd to forbear the *Rent*, *Penſion*, or *Annuity*, payable to my ſelf, a certain *Time*, and receive for ſuch Forbearance, after the Rate of *Simple Intereſt*, for every Payment, as it became due, at ſuch *Rate* as ſhall be agreed on; though 'tis indeed uſual to reckon theſe *Caſes* by *Compound Intereſt*; but of late *Years*, ſince the *Intereſt* of *Money* is become very low, and the Conveniences ariſing to the Purchaſer of ſuch *Fines*, *Annuities*, &c. are oftentimes very great, 'tis frequently done this Way; and at all Adventures, I may ſurely make Calculations of this Sort, and alſo of the other; and when I have ſo done, and compared the Reſult of the two Ways, 'tis reaſonable I ſhould be at liberty to comply with either of them, as my preſent Occaſions, Neceſſities, or Conveniences, ſhall dictate to me. Here you are to obſerve, that ſo often as an *Annuity* or *Rent*, &c. is to be paid, whether once, twice, &c. in a *Year*, 'tis here underſtood to be, and is called a *Time*. Therefore, if any *Rent*, *Annuity*, &c. with the *Times* it ought to be paid, and the *Rate* of *Intereſt*, that is to be reckon'd, is given, to find what the *Total Amount* or *Sum* of all thoſe *Arrears* will come to in *preſent Money*,—You muſt

*Multiply the Number of Times of Payment by itſelf, made leſs by Unity, and this Product again by half the Ratio of the Rate of Intereſt: To this laſt Product add the Number of Times of Payment; multiply this Sum by the Annuity, Rent,* &c. *and this laſt Product will be the Anſwer ſought after.*

## *EXAMPLE.*

*Suppoſe I have a Bond, an Annuity, or a Rent of* L. 250 *per Annum, but to accomodate the Perſon that is to pay it, I agree to let the ſame lie in his Hands for* 9 *Years, for which he is to allow me* Simple Intereſt, *after the Rate of* 5 *per Cent. per Annum for each Payment, as it becomes due, What will the whole amount to?*

9 the *Number* of *Times* of *Payment.*
8 one leſs than the *Payments.*

72 the *Product.*
,025 half the *Ratio* of the *Rate* of *Intereſt.*

10,800 the *Prod.* added to the Times of Payment.
250 the *annual Payment.*

2700,0 the *Product*, which is the *Amount* of the whole *Principal* and *Intereſt.*

Which

Which may be eaſily proved: Thus,

| | | | |
|---|---|---|---|
| The firſt *Payment* | is | L. 250 | and it lies 8 *Years*, |
| *Intereſt* in that Time | is | 100 | |
| Second *Payment* | is | 250 | and it lies 7 *Years*, |
| *Intereſt* in that Time | is | 87,5 | |
| Third *Payment* | is | 250 | and it lies 6 *Years*, |
| *Intereſt* in that Time | is | 75 | |
| Fourth *Payment* | is | 250 | and it lies 5 *Years*, |
| *Intereſt* in that Time | is | 62,5 | |
| Fifth *Payment* | is | 250 | and it lies 4 *Years*, |
| *Intereſt* in that Time | is | 50 | |
| Sixth *Payment* | is | 250 | and it lies 3 *Years*, |
| *Intereſt* in that Time | is | 37,5 | |
| Seventh *Payment* | is | 250 | and it lies 2 *Years*, |
| *Intereſt* in that Time | is | 25 | |
| Eighth *Payment* | is | 250 | and it lies 1 *Year*, |
| *Intereſt* in that Time | is | 12,5 | |
| Ninth *Payment* | is | 250 | upon which no *In-* |

*tereſt* is due, and the *Total* is L. 2700

In the above *Queſtion*, you are to obſerve, that the firſt Year's Rent pays *Intereſt* but for eight *Years*; becauſe one *Year* is ſuppoſed to be expired before it becomes due; and the laſt *Year's Rent* pays no *Intereſt*, becauſe the Whole is ſuppos'd then to be paid off: And conſequently, that theſe ſeveral *Payments*, and the *Intereſt* upon them, form a *Series* of *Numbers* in *Arithmetical Progreſſion*, whoſe firſt *Term* is 350, *viz.* the *Sum* of the *Rent* and its *Intereſt*, and the laſt *Term* 250, and the *common Exceſs* or *Difference* is 12,5, *viz.* the *Intereſt* of L. 250 for one *Year*, and the *Number* of Terms 9, as appears by the above Particulars, where the *Sum* of the firſt *Payment*, and the *Intereſt* is L. 350, and the laſt *Payment* is L. 250 only, becauſe it has no *Intereſt*; ſo that by the *Rule*, Page 325, you may eaſily get the *Sum Total* that is due, thus:

350 the firſt or biggeſt *Term*.
250 the laſt or ſmalleſt *Term*.

600 the *Total* of both.
9 the *Number* of *Terms*.

2 | 5400 the *Product* divided by 2 gives

2700 the *Sum* of all the *Series*, which is the *Amount* of the *Annuity*, both *Principal* and *Intereſt* for the *Time*.

2. Suppoſe the *Amount*, *Time* and *Rate* of *Intereſt* to be given, and the *Annuity* was requir'd.

## *RULE.*

*Multiply the Number of Payments by it ſelf, leſs Unity, and that* Product *by half the Ratio of the Rate, and to this laſt Product add the Time or Number of Payments, and make this Sum the Diviſor, and the Total Amount the Dividend, and the Quotient will be the Anſwer ſought.*

*N. B.* The *Ratio* of the *Rate* of *Intereſt*, is the *Intereſt* of L. 100. *divided* by the *Principal.* Thus the *Ratio* of 5 *per Cent.* is ,05 of 4 *per Cent.* is ,04 of 3 *per Cent.* ,03, *&c.*

*What Rent or Annuity to be paid Yearly, at 5 per Cent. per Ann.* Simple Intereſt, *will amount to L.* 2700 *in nine Years Time?*

## *EXAMPLE.*

9 the Number of Payments.
8 ditto leſs Unity

72 Product.
,025 half the Ratio.

360
144

1,800 Product.
9 - - Times of Payment.

10,8 Total to be the Diviſor.

Dividend.
10,8)2700(250 Quotient.

So that an *Annuity*, or *Rent* of L. 250 *per Annum*, forborn to the End of the 9th *Year*, or *Time* of *Payment*, will be the Anſwer.

Or, you may ſuppoſe L. 1 to be the Annuity, and work as in the laſt *Example*, and the Anſwer will come out L. 10,8.

Then ſay, As L. 10,8 is to L. 1 ſo is L. 2700 to L. 250. Thus by the Rule in Page 325,

L. 1 *Annuity.*
,4 the *Intereſt* at 5 per *Cent.* for 8 *Years.*

1,4 the *Sum* is the firſt and biggeſt *Term* of the *Series.*
1 - the laſt and ſmalleſt *Sum* of the *Series.*

2,4 the *Total* of the firſt and laſt Term.
9 the Number.

2 | 21,6 the Product.

10,8 the Total Amount of an Annuity of L. 1 *per Annum,*

*Annum*, forborn for 9 Years, with the Allowance of L. 5 *per Cent. per Annum*, Simple Intereſt, for the ſeveral Payments, as they became due.

3. If the *Annuity*, *Total Amount*, and *Rate* of *Intereſt* is given, to find the *Time*. The Rule is,

*Subſtract the Ratio of the Rate from* 2, *and divide the Remainder by the Double of the* Ratio; *then ſquare this Quotient, and add this Square to the Quotient ariſing, by dividing the Double of the Total Amount by the Product of the Annuity, multiply'd by the Ratio; then extract the Square Root of that Sum, and from this Root ſubſtract the firſt Quotient, and the Remainder will be the Number of Times of Payment ſought.*

## *EXAMPLE.*

*In what Time will a Yearly Penſion, Rent, or Annuity of L.*250 *per Annum, amount to L.*2700, *allowing* Simple Intereſt *at L.* 5 *per Cent. per Annum?*

2 - the whole *Number* 2.
,05 the *Ratio* of the *Rate* to be *ſubſtracted*.

,1)1,95 *Remain.* to be divided by ,1 the *double* of the *Ratio*.

19,5 the *Quotient*.
19,5

975
1755
195

380,25 the *Square* of 19,5 the *Quotient*.

L. 2700 the propos'd *Amount* multiply'd by 2

12,5)5400 the *Product* or double of the Amount which is to be a Dividend.
50,0

400 (432 Quotient. 250 *Annuity*.
37,5 ,05 the *Ratio*.

25,0 12,50 the *Prod.* or *Diviſ.*
25,0

..

432 the *Quotient* above.
380,25 the *Square* of 19,5.

812,25 the *Sum* from which the *Square Root* is to be *extracted*.

28,5 the *Root*.
19,5 the firſt *Quotient*.

9, the Remainder is the *Years* or *Times* of *Payment*.

*N. B.* In this laſt Caſe, there is given a Series of Numbers in *Arithmetical Progreſſion*, in which the Sum of all the Terms, the common Difference, and the firſt or laſt Term is given, to find the Number of Terms.

4. *The Annuity, Rent, or Penſion to be annually, &c. paid, the whole Amount both of Principal and Intereſt, and the Time being given, to find the Rate of Intereſt.*

The RULE is,

*Multiply the Annuity firſt by the whole Time, or Number of Payments, and alſo by the Square of the Time, and ſubſtract the leſſer Product from the greater, and divide the Remainder or Difference by 2, the Quotient will be a Diviſor. Then ſubſtract the Product of the Annuity by the ſingle Time, from the whole Amount, and divide the Remainder by the above Diviſor, and the Quotient will be the Ratio of the Rate of Intereſt ſought, which multiply by* 100, *and the Product will be the Rate itſelf.*

*EXAMPLE.*

*Suppoſe I have an Eſtate of* L. 250 per Annum, *to be paid Yearly, which I agree ſhall lie nine Years, at the End of which Time I am to receive* 2700, *What is the Rate of* Simple Intereſt, *that I am to be allow'd* per Cent. per Annum?

250 the given Annuity.
9 the Time.

2250 the Product.

2700 the *Total Amount*.
2250 the *Product* of the *Rent*, and *Time*.

450 the Remainder to be a Diviſor.

250

250 the *Rent.*
81 the *Square* of the *Time.*

250
2000

20250 the *Product.*
2250 the *Prod.* of the *Annuity* by the ſingle *Time.*

2)18000 the *Remainder.*

9000 the *Quotient* or *Diviſor.*

9000) 450,00 (,05 the Quotient or Ratio of the Rate.
450,00

.....

,05 the *Ratio* of the *Rate.*
100 the *Principal* to the *Rate.*

5,00 the *Product*, which is the *Rate* ſought.

*In the above Caſe there is given the firſt Term, the Sum of all the Terms, and the Number of Terms in an Arithmetical Series, to find the common Exceſs.*

Sufficient has now been ſaid for yearly Payments, and if the Queſtion is about half-yearly or quarterly Payments,

*Inſtead of the Ratio of the Rate given, you muſt take its Half or its Quarter, and alſo the* $\frac{1}{2}$ *or the* $\frac{1}{4}$ *of the yearly Rent or Payment; and inſtead of the Number of whole Years, you muſt take its Double for half-yearly Payments, and its Quadruple for Quarterly Payments:* As in the following Examples.

*If I have a Penſion of* L. 250 per Annum, *payable half Yearly, and it is unpaid for* 9 *Years, What muſt I receive at the End of that Time, and be allowed* L. 5 *per* Cent. Simple Intereſt *for every Payment, as it becomes due?*

PRE-

## *PREPARATION.*

L. 125 the *half-yearly* Payment, or ½ of L. 250.

,025 the *Ratio* of the *Rate* for *half-yearly* Payments, or ½ of ,05

18 the *Number* of *Times* of *Payment*, or 9 *Years* multiply'd by 2.

17 the *Number* of *Times*, leſs *Unity*.

,0125 the *Half* of the *Ratio* of the *Rate* for ½ Year.

18 the *Times* or *Payments*.
17 Ditto leſs 1.

126
18

306 the *Product*.
,0125 the *Half* of the *Ratio* of the *Rate*.

1530
612
306

3,8250 the *Product*.
18 —— the *Time*.

21,825—the *Total*.
125—the *Annuity*.

109125
43650
21825

2728,125 the *Product* or *Total Amount*.

Here you ſee, that by having the *Payments half-yearly*, there is L. 28 : 2 : 6 more gain'd than by having them *Annually*.—Again,

*Suppoſe I am to receive a Penſion of* L. 250 per Annum *Quarterly, and I agree to let it lie* 9 *Years, What muſt I receive*

*receive at the End of that Time, if I am allowed* Simple Intereſt, *at the Rate of L.* 5 per Cent. per Annum?

*PREPARATION.*

L. 62,5 the *Quarterly Payment*, or $\frac{1}{4}$ of L. 250.

,0125 the *Ratio* of the *Rate* for *Quarterly Payments.*

36 the whole Number of Payments.

35 Ditto, leſs Unity.

,00625 the *Half* of the *Ratio* of the *Rate.*

36 the Number of Payments.
35 Ditto leſs 1.

180
108

1260 the *Product.*
,00625 the *Half* of the *Ratio* of the *Rate.*

6300
2520
7560

7,87500 the *Product.*
36,—— the *Time.*

43,875 the *Total.*
62,5 the *Annuity* or *Penſion.*

219375
87750
263250

2742,1875 the *Product* or *Total Amount.*

By this *Example* you may obſerve, that the *Proprietor* of any ſuch *Penſion*, *Rent* or *Annuity*, will gain L. 42 : 3 : 9 more by being paid *Quarterly*, than by being paid *Annually.*

The

*The preſent Worth of Rents, Annuities,* &c. *at* Simple Intereſt.

Here, as before, are *four Caſes*; the firſt and moſt *general* one is,

When the *Annuity, Rent,* or *Penſion,* the *Time* it is to continue, and the *Rate* of *Intereſt* to be allowed is known, to find the *Money* that muſt be paid down immediately for the ſame.

## *EXAMPLE.*

*Suppoſe I rented a Farm of L.* 450 *per Annum, and my Landlord wanting Money is willing I ſhould buy off L.* 250 *per* Annum *for* 21 *Years, viz. the Term of my Leaſe, and allows me to diſcompt* 4 per Cent. per Annum, *Simple Intereſt, What Sum muſt I pay down immediately, if the Payments were to be made half-yearly?*

## *RULE.*

*Multiply the Time, the Time leſs Unity and half the* Ratio *continually together, and to their Product add the Time, multiply this Sum by the Rent, or Penſion,* &c. *and this Product muſt be a Dividend; then multiply the* Ratio *into the Time; and to the Product add Unity, and this Sum muſt be a Diviſor, by which dividing the above Dividend, the Quotient will be the preſent Worth, or Sum to be paid down immediately.*

## *PREPARATION.*

L. 125 the *half-yearly* Payment, or ½ of L. 250.

42 the whole *Time* or *Number* of *Payments*, or *twice* 21 *Years.*

41 Ditto leſs *Unity.*

,02 the *Ratio* of the *Rate* for ½ Year.

,01 half the *Ratio* of the *Rate.*

42 the *Time.*
,02 the *Ratio.*

,84 the *Product.*
1,— to be added.

1,84 the *Sum* and *Diviſor.*

42 the

42 the whole *Time.*
41 Ditto leſs *Unity.*

42
168

1722 the *Product.*
,01 half the *Ratio.*

17,22 the *Product.*
42 — the *Time.*

59,22 the *Sum.*
125 the *Annuity.*

29610
71064.

1,84)7402,50(the *Product* and *Dividend.*
736

42,5 4023,0978, &c. the *Quotient.*
368 Or,
L. 4023 : 1 : 11½ the *preſent Worth.*
570
552
18, &c.

2. If the *preſent Worth*, the *Time*, and the *Rate* of *Intereſt* are given, to find the *Annuity.*

*The* RULE *is,*

*Multiply the Time, the Ratio of the Rate, and the preſent Worth continually together, and to the laſt Product add the preſent Worth; and that Sum muſt be a Dividend.*

*Then multiply the Time, the Time leſs Unity, and half the Ratio of the Rate continually together, and to the laſt Product add the Time; and this Sum muſt be a Diviſor to the above Dividend, and the Quotient ariſing from theſe two will be the Annuity, Rent or Penſion ſought after.*

### *EXAMPLE.*

*What Annuity,* &c. *may I have for* L. 4023 : 2 : -, *to be paid down immediately, and to continue for* 21 *Years, payable every half Year, allowing* Simple Intereſt, *at* 4 *per Cent. per Annum?*

42 the *Time.*
,02 the *Ratio* of the *Rate.*

,84 the *Product.*
4023,1 the preſent *Worth.*

160924
321848

3379,404 the *Product.*
4023,1— the preſent *Worth.*

7402,504 the *Sum* and *Dividend.*

42 the *Time.*
41 Ditto leſs 1.

1722 the *Product.*
,01 half the *Ratio* of the *Rate.*

17,22 the *Product.*
42 — the *Time.*

59,22 the *Sum* and *Diviſor.*

59,22) 7402,504 (125 the *Quotient,* which is the half-yearly *Rent,* or *Penſion* to be paid.

3. If the *Rent,* preſent *Worth* and *Rate* of *Intereſt* is given, to find the *Time* of Continuance.

### *The RULE is,*

*To the preſent Worth add half the Annuity, and multiply this Sum by the Ratio of the Rate, and ſubſtract the Product from the Rent or Penſion, and divide the Remainder by the Product of the Rent, multiply'd by the Ratio, and ſquare the Quotient;*

*Quotient; alſo divide the preſent Worth by the Product of the Rent, multiply'd by the Ratio, and to double the Quotient add the Square abovementioned, and extract the Square Root of the Total; and from the ſaid Root ſubſtract the Product of the Rent, multiply'd by the Ratio, and the Remainder will be the Time ſought after.*

*Suppoſe I pay down* L. 4023 : 2 : — *to receive* L. 125 *every half-year, How many Years muſt I receive this Rent, or Penſion, to be allowed* 4 *per Cent. per Annum,* Simple Intereſt, *for my Money?*

L. 4023,1 the preſent *Worth.*
62,5 the $\frac{1}{2}$ of the $\frac{1}{2}$ yearly *Payment.*

4085,6 the *Sum.*
,02 the *Ratio* of the $\frac{1}{2}$ yearly *Rate.*

81,712 the *Product.*
125 — the $\frac{1}{2}$ yearly Payment.

43,288 the *Difference,* which is alſo to be a *Dividend.*

L. 125 the *Annuity.*
02 the *Ratio* of the *Rate.*

2,50 the *Product,* which is to be a common *Diviſ.*

2,5 | 43,288 (17,316 the *Quotient.*
17,316

299,843856 the *Product* called the *Square.*

2,5 | 4023,1 (1609,24 the *Quotient.*
2

3218,48 the double *Quotient.*
299,843856 the Square above.

3518,323856 the Sum.

59,316 the Square Root.
17,316 the firſt Quotient.

42, — the Difference, which is the Number of *Times* of *Payment*, viz. 42 *half Years*, or 21 *Years*.

4. If the *Annuity*, preſent *Worth*, and *Time* are given, to find the *Rate* of *Intereſt*,

*The* RULE *is*,

*Multiply the Annuity and Time together, and ſubſtract the preſent Worth from that Product, and multiply the Remainder by* 200, *and that Product will be a Dividend. Then add the Annuity to the Double of the preſent Worth, and ſubſtract the firſt Product above from this Sum, and multiply the Remainder by the Time, and this Product will be a Diviſor to the above Dividend, and this Quotient will be the Rate of Intereſt ſought for the Time of Payment.*

## *EXAMPLE.*

Suppoſe I give L. 4023,2 for an Annuity of L. 250 *per Annum* to be paid half-yearly for 21 Years, *What Rate of* Simple Intereſt *am I allowed?*

L. 125 the *half-yearly* Payment.
42 the *Number* of *Payments*.

5250 the *Product*.
4023,1 the preſent *Worth*.

1226,9 the *Remainder*.
200

2453 80,0 the *Product*, which is to be a *Divid.*

L. 4023,1

L. 4023,1 the preſent *Worth.*
2

8046,2 double the preſent *Worth.*
125— the *Annuity.*

8171,2 the *Sum.*
5250— the firſt *Product.*

2921,2 the *Remainder.*
42 the *Time.*

58424
116848

122690,4 the *Product*, which is to be the *Diviſor* to the above *Dividend.*

122690,4)245380 — (L. 2. the *Quotient*, which is the *Rate* of *Intereſt* for the *Half-year.*

*N. B.* There is in this, and the two foregoing *Examples*, a trifling Difference, ſometimes wanting, and ſometimes abounding, which ariſes from making the preſent worth an Half-penny too much, which is done to ſave the Numbers from running out very largely.

What has been already taught, is ſufficient to anſwer any thing that can be propoſed, when the *Rent*, *Penſion*, or *Annuity* is to begin immediately; but ſuppoſe I buy the Reverſion of an Eſtate, Leaſe, *&c.* that is, I am not to be in Poſſeſſion till 7, 8, 10, *&c.* Years hence: In this Caſe,

*The* RULE *is,*

*Firſt, find what is the preſent Worth of the propos'd Rent,* &c. *for the Time you are to have it, as if it was now really in your Poſſeſſion.*

*Then, to find what Sum forborn for the Time of the Reverſion would raiſe the aforeſaid Value, you muſt multiply the Time you are to be out of Poſſeſſion, by the* Ratio *of the* Rate *of Intereſt, and to that* Product *add* 1; *by this Sum divide the preſent Worth, found by the* Rule *in Page* 384, *and the Quotient will be the Sum to be paid down immediately.*

EX-

## *EXAMPLE.*

*Suppoſe there is a Rent or Annuity of* L. 250 *per Annum, to be paid Yearly, that is to continue for* 21 *Years, in which the preſent Poſſeſſor has ſeven Years ſtill to come, What immediate Money muſt I pay down for the remaining* 14 *Years, to be allow'd* 4 *per Cent. per Annum,* Simple Intereſt, *for the Money the whole Time.*

Here, by the Rule, *Page* 384, the preſent *Worth* of L. 250 per *Annum* for 14 *Years* to come, at 4 per *Cent. Simple Intereſt*, is L. 2826 : 18 : 5 ½; and by the *Rule* above, the preſent *Worth* of L. 2826 : 18 : 5 ½ to be paid 7 *Years* hence, diſcompting *Intereſt* at 4 per *Cent.* per *Annum*, is L. 2208 : 10 : 8, which laſt *Sum* is what muſt be paid down immediately for the above *Purchaſe.*

## *Compound INTEREST.*

This is ſo called, becauſe the *Intereſt* of a particular *Sum*, not being paid, as it becomes due, is turned into a *Principal*; ſo that both the *Principal* and *Intereſt* continually increaſes in a certain *Proportion*, though the *Quantity* of *Time* is always the ſame: And as *Queſtions* in *Simple Intereſt* form'd a *Series* of *Numbers* in *Arithmetical Progreſſion*, ſo *Queſtions* in *Compound Intereſt* form a *Series* of *Numbers* in *Geometrical Progreſſion.*

## *EXAMPLE.*

*What will L.* 250 *amount to in* 9 *Years, at* Compound Intereſt, *reckoning* 5 per Cent. per Annum?

The beſt and moſt conciſe Method of doing ſuch *Queſtions* as theſe, is by *Logarithms*; but as we have not treated of them, nor have we Room to exhibit *Tables* of them, we ſhall ſay nothing more upon that Head, but ſhew you how to anſwer ſuch like *Queſtions* by common *Numbers.* Now you may operate for the above Sum, or any other, directly, as follows.

250
5
12,50

The Amount at the Year's End 262,5

5
13,125

Ditto at 2 Years End. 275,625

5
13,78125

Ditto at 3 Years End 289,40625

5
14,4703125

Ditto at 4 Years End 303,8765625

5
15,193828125

Ditto at 5 Years End 319,070390625

5
15,9535195 3125

Ditto at 6 Years End 335,02391(015625

5
16,751195 5

Ditto at 7 Years End 351,775105 5

5
17,588755275

Ditto at 8 Years End 369,3638(60775

5
18,468193

Ditto at 9 Years End 387,831993

But

But if you calculate the *Amount* of L. 1 for a *Series* of *Years*, ſuppoſe 31, or any other *Number*, at ſeveral *Rates*, their *Amounts* will be ſo many fix'd *Numbers* for thoſe particular *Times* and *Rates*, by which, multiplying any given *Sum*, you will have the *Amount* of that *Sum* for that *Time* at that *Rate:* Thus,

| | |
|---|---|
| | 1, . . |
| | 5 |
| | ,05 |
| 1 Year | 1,05 |
| | 5 |
| | ,0525 |
| 2 Years | 1,1025 |
| | 5 |
| | ,055125 |
| 3 Years | 1,157625 |
| | 5 |
| | ,05788125 |
| 4 Years | 1,2155(0625 |
| | 5 |
| | ,060775 |
| 5 Years | 1,276275 |
| | 5 |
| | ,06381375 |
| 6 Years | 1,34008875 |
| | 5 |
| | ,0670044375 |
| 7 Years | 1,4071(931875 |
| | 5 |
| | ,070355 |

L. 1 for 9 Years 1,55133
the given Sum 250

7756650
310266

L. 387,83250

Or, L. 387,16,8 *fere.*

8 Years

8 Years 1,477455
5

,07387275

9 Years 1,55132775 and so on for as many Years as you please.

Here the *Amount* of L. 1 for 9 *Years* is L. 1,55133 *fere*, which *multiplying* by L. 250, the given *Sum*, and the *Answer* is L. 387,8325, the same with the other; and as these fix'd *Numbers* are so exceeding useful. Here follows a *Table* for the *Amount* of L. 1 for 31 Years, for 3, 4 and 5 *per Cent.*

| Years | 5 *per Cent.* | 4 *per Cent.* | 3 *per Cent.* |
|---|---|---|---|
| 1 | 1,05 | 1,04 | 1,03 |
| 2 | 1,1025 | 1,0816 | 1,0609 |
| 3 | 1,157625 | 1,124864 | 1,092727 |
| 4 | 1,2155 | 1,169856 | 1,125509 |
| 5 | 1,276275 | 1,216651 | 1,159274 |
| 6 | 1,340088 | 1,265318 | 1,194052 |
| 7 | 1,4071 | 1,315931 | 1,229878 |
| 8 | 1,477455 | 1,368567 | 1,26677 |
| 9 | 1,55133 | 1,42331 | 1,304773 |
| 10 | 1,6289 | 1,480242 | 1,343916 |
| 11 | 1,71034 | 1,539452 | 1,384233 |
| 12 | 1,79586 | 1,60103 | 1,425761 |
| 13 | 1,885651 | 1,665071 | 1,468533 |
| 14 | 1,979934 | 1,731674 | 1,512589 |
| 15 | 2,07893 | 1,800941 | 1,557967 |
| 16 | 2,18288 | 1,87298 | 1,604706 |
| 17 | 2,29203 | 1,9479 | 1,652847 |
| 18 | 2,40663 | 2,025816 | 1,702432 |
| 19 | 2,52696 | 2,106848 | 1,753506 |
| 20 | 2,65331 | 2,191123 | 1,706111 |
| 21 | 2,785965 | 2,278767 | 1,757294 |
| 22 | 2,925263 | 2,269918 | 1,811013 |
| 23 | 3,071526 | 2,360715 | 1,865343 |
| 24 | 3,2251 | 2,455143 | 1,921303 |
| 25 | 3,386355 | 2,553349 | 1,978942 |
| 26 | 3,555673 | 2,655483 | 2,038311 |
| 27 | 3,733456 | 2,761702 | 2,09946 |
| 28 | 3,92013 | 2,872171 | 2,162444 |
| 29 | 4,116136 | 2,987057 | 2,227217 |
| 30 | 4,321943 | 3,106539 | 2,294034 |
| 31 | 4,53804 | 3,2308 | 2,362854 |

The Uſe of theſe Tables is to find what any Sum at 3, 4, or 5 *per Cent. per Annum*, amounts to, being forborn any Number of Years, not exceeding 31, at Compound Intereſt.

## EXAMPLE.

*What is the Amount of* L. 718 : 13 : 6 *for* 27 *Years, at* 4 *per Cent.* Compound Intereſt?

2,761702 is the Amount of L. 1.
718,675 the Sum given.

1984,766 the Product.

Or,

L. 1984 : 15 : 3¼ the Amount; and ſo for any other *Sum* or *Rate*.

*At* 5 *per Cent. per Annum* Compound Intereſt, *What Sum will amount to* L. 387 : 16 : 8 *in* 9 *Years?*

Here look out the *Tabular Number* for 9 *Years*, viz. 1,55133, and *divide* the given *Sum* L. 387,833, &c. by it, and the *Quotient* L. 250 is the *Sum* ſought.

Again, *What Time will it require to raiſe* L. 250 *to* L. 387 : 16 : 8 *at the Rate of* L. 5 *per Cent. per Annum*, Compound Intereſt?

Here you muſt *divide* the biggeſt *Sum* by the leaſt, and the *Quotient* 1,55133 will be the *Amount* of L. 1; then look how long L. 1 will be in raiſing that *Sum*, and againſt 9 *Years*, you will find it; ſo that ſhews, that in 9 *Years* L. 250 will amount to the given *Sum*: But if you have no Tables, and are deſirous to find the Time Arithmetically, divide the ſaid Quotient 1,55133 by 1,05 the Amount of L. 1 for 1 Year, till the Remainder is 0, which here will be at the 9th Operation, which ſhews that the Time is 9 Years, *viz.*

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| 1,05) 1,55133 | (1,47746 | (1,40711 | (1,34010 | (1,27630 |
| 5 | 6 | 7 | 8 | 9 |
| 1,21552 | (1,15764 | (1,10251 | (1,05 | (1. |

Again, *If* L. 250 *will amount to* L. 387 : 16 : 8 *in* 9 *Years, What is the Rate of Intereſt?*

Anſ. 5 per *Cent.* per *Annum.*

Here

Here you muſt, as before, *divide* the *Amount* by the *Principal*, and with the *Quotient*, 1,55133, enter the *Table* at 9 *Years*, and under the *Column* of 5 per *Cent.* is the *Number* ſought; from whence may be concluded that 5 per *Cent.* is the *Rate:* But if you would do it *Arithmetically* without *Tables*, then *extract* the 9th *Power* out of 1,55133, and the *Root* will be the *Anſwer* ſought. Or, if you *extract* the *Cube Root* out of this 1,55133, and again, the *Cube Root* of that *Root*, you will have 1,05 come out for the laſt Root, which is the Amount of L. 1 for 1 *Year*, at 5 per *Cent.* per *Ann.* Compound Intereſt.

But it may ſo happen, that the *Time* may not always be *whole Years*. In this *Caſe* Exactneſs requires a very tedious Proceſs, and inſtead of multiplying by 1,05 for 5 per *Cent.* 1,04 for 4 per *Cent.* &c. you ſhould find the *Amount* of L. 1 for 1 Day, but not as in Page 370, where 'tis ,000137 for 5 per *Cent.* ,0001096, for 4 per *Cent.* ,00009561 for 3 ½ per *Cent.* and ,0000822 for 3 per *Cent.* but by *Tables* form'd from 1 *Day* to 365, at the ſeveral Rates required, though this is indeed a Matter of much greater Niceneſs than is ever uſed; and ſo I ſhall forbear purſuing this Subject any farther, and go to

## *RENTS, LEASES, PENSIONS,* or *ANNUITIES,* computed at *Compound Intereſt.*

You are to Note, that in theſe Sort of Purchaſes, *Compound Intereſt* is generally ſuppoſed to be allowed to make good extra Trouble or Loſs by Tenants, *&c.*

### *EXAMPLE.*

*What is the Amount of* L. 30 *per* Annum *forborn* 9 *Years, at* 5 *per* Cent. per Annum, *Compound Intereſt?*

Anſwer, L. 330 : 16.

Here the *Amount* of L. 1 by the *Table* is 1,55133; this *multiply'd* by the *Annuity* is L. 46,53990, from which *ſubſtract* the *Annuity*, and the *Remainder* is L. 16,5399; this *divided* by the *Ratio* of the *Rate* gives L. 330 : 16 for the *Amount*, as will appear by the following Work at large.

L. 30, the firſt *Year's* Income.
1,50 Intereſt for the ſecond *Year* of L. 30.
30 the ſecond *Year's Rent.*

61,5

61,5 due at the End of the ſecond *Year.*
33,075 the third *Year's Rent* and *Intereſt* of L. 61,5.

94,575 *Total* due the third *Year.*
34,72875 the fourth *Year's Rent* and *Intereſt* of L. 94,575.

129,30375 *Total* due the fourth *Year.*
36,46519 the fifth *Year's Rent* and *Intereſt* of L. 129,303.

165,76894 *Total* due the fifth *Year.*
38,28845 the ſixth *Year's Rent* and *Intereſt* of L. 165,768

204,05739 *Total* due the ſixth *Year.*
40,20287 the 7th *Year's Rent* and *Intereſt* of L. 204,057

244,26026 *Total* due the ſeventh *Year.*
42,21303 the 8th *Year's Rent* and *Intereſt* of L. 244,260.

286,47329 *Total* due the 8th *Year.*
44,32366 the 9th *Year's Rent* and *Intereſt* of L. 286,473.

330,79695 *Total* due the 9th *Year.*

Or, L. 330 : 15 : 11 $\frac{1}{4}$, the ſame with the above, within 3 Farthings.

Again, *What Rent or Annuity, forborn 9 Years, will amount to L.* 330 : 16, *reckoning* Compound Intereſt *at 5 per Cent. per Annum?*

Here you muſt multiply L. 330 : 16, by the Amount of L. 1 for 1 Year, *viz.* L. 1,05, and from the Product L. 347,340 ſubſtract the whole Amount L. 330,8, and divide the Remainder 16,54 by the Amount of L. 1. for the whole *Time*, made leſs by *Unity*, viz. ,55133, and the *Quotient* L. 30 will be the *Anſwer* ſought.

Here you are to Note, that if the *Payments* are to be made *Half-yearly* or *Quarterly*, that though the *Rate* of *Intereſt*, and the *principal Sum* or *yearly Rent* is the ſame, the *Amount* will not be the ſame.

We might continue to go on to *Diſcompts*, or the preſent Value of *Rents*, *Annuities*, &c. but as the *Proceſſes* for theſe Purpoſes are very prolix in *common Arithmetick*, and ſeveral have performed them very accurately by the *Logarithmick Tables*, and alſo by *Tables* calculated on purpoſe for thoſe, who have not either the Leiſure or the Skill to work the

ſame

ſame Numerically, I forbear ſaying any more upon this Head.

I ſhould now go on to the Rule called, *The Rule of falſe Poſition, ſingle and double:* But as that Rule is chiefly made uſe of in ſportive Queſtions, or ſuch as ſeldom or never occur in practical Buſineſs; and as a very ſmall Knowledge of *Algebra* ſurpaſſes any thing doable by thoſe Rules, I omit ſaying any thing of them; adviſing thoſe who have ſtudied this Book thoroughly, and want ſtill more Perfection in this Science, to apply themſelves to the Study of *Algebra*, for their final Completion.

*F I N I S.*

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